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A MONOGRAPH

OF THE

TERRESTRIAL CARBONIFEROUS ARACHNIDA

OF

GREAT BRITAIN.

BY

REGINALD INNES POCOCK, F.L.S.,

SUPERINTENDENT OF THE ZOOLOGICAL SOCIETY'S GARDENS, REGENT'S PARK, LONDON.

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A MONOGRAPH

OF THE

TERRESTRIAL CARBONIFEROUS ARACHNIDA OF GREAT BRITAIN.

I.—INTRODUCTION.

Most of the material upon which this monograph is based came from Coseley, near Dudley, and was kindly lent to me by the following gentlemen, to whom my grateful thanks are due: Dr. Wheelton Hind, Mr. S. Priest, Mr. Henry Johnson, the late Mr. William Madeley, and Mr. Walter Egginton. I am also greatly indebted to the Director of the Geological Survey and to Dr. Kitchin for the loan of specimens from the Survey Museum in Jermyn Street; to Dr. Smith Woodward, the Keeper, and to Dr. F. A. Bather, the Assistant-Keeper, of the Geological Department of the British Museum, not only for the loan of specimens, but also for the privilege of free access to the collection of fossil Arachnida in that institution; to Dr. Henry Woodward for the opportunity to examine and describe examples that had been entrusted to him by Dr. Moysey, Mr. W. A. Parker, and Mr. F. Holt; and to Mr. Robert Dunlop for two very interesting specimens from Scotland. Without the help thus generously afforded, the present work could not have been attempted. Finally, I wish to thank Miss Gertrude M. Woodward for the care she has taken in the execution of the plates and text-figures illustrating this monograph.

The species forming the subject-matter of the following pages are referred to seven orders: Scorpiones, Pedipalpi, Araneæ, Ricinulei, Haptopoda, Phalangiotarbi, and Anthracomarti, one species doubtfully belonging to the Opiliones. The Haptopoda, Phalangiotarbi, and Anthracomarti are, so far as is known, wholly extinct. I am unable to offer any satisfactory suggestion as to the cause of their extinction, there being nothing in their organisation very obviously calculated to make them less fitted for survival than the Ricinulei. The reason for the survival of Scorpiones and Pedipalpi is perhaps to be found partly in their possession of

powerful chelate palpi. But in addition to these efficient prehensile organs the Scorpiones have a poisonous sting; the Uropygous Pedipalpi have protective acid-glands at the tip of the opisthosoma, while the Amblypygi are extraordinarily quick in their movements and have a highly specialised tactile organ in the legs of the first pair. The Araneæ have probably survived in virtue of their snare- and cocoon-making spinning glands, coupled with poison-glands in the mandibles; and there is some evidence that existing Opiliones are protected by their scent-glands. Since there is no reason to suppose that the members of the extinct orders above enumerated had specialised glands either for offensive or defensive purposes, and since their palpi were short and non-prehensile, and their organisation suggests that they were comparatively slow-moving, cryptozoic forms, it might be supposed that these attributes supply the needed explanation, were it not that the Ricinulei resemble them in most of these particulars. One thing, however, must not be forgotten. An important factor in the evolution of terrestrial Arachnida has been, in my opinion, a change from the method of pairing, as practised by Scorpions, to new and special methods, resulting in the modification of a part of one of the prothoracic limbs into an intromittent organ, often of great complexity. This may be seen in the Araneæ, where the palpi are modified, in the Solifugæ, where the mandibles are modified, in some of the Acari, and lastly in the Ricinulei, where the legs of the third pair are modified. Even the Opiliones possess very special secondary reproductive organs. There is no evidence, nor any reason to suppose, that the Haptopoda, Phalangiotarbi, or Anthracomarti had departed from the normal in their breeding habits; and it is quite conceivable that the Ricinulei have outlasted their Carboniferous contemporaries belonging to those three orders on account of their very specialised methods of copulation.

Up to the present time the only orders of Arachnida known to be represented in British Carboniferous strata, belong to the Scorpiones, the Phalangiotarbi, and the Anthracomarti. Of Scorpiones several species have been described, mostly by Dr. Peach from Scotland; one species of Phalangiotarbi was named many years ago by Dr. Woodward; while of Anthracomarti some five species have been made known by Dr. Woodward and myself. As an historical fact it is interesting to record that in 1826 Dean Buckland described two Arachnida as Coleopterous insects. One of these was detected to be an Arachnid by Dr. Woodward, and the other I have now been able to identify as also belonging to that class.

The material at my disposal has shown that the British Carboniferous fauna is at least as rich in species and genera of Arachnida as that of Continental Europe and North America, the species of which have been described for the most part respectively by Kusta and Fritsch and by Scudder. Fritsch can hardly be acquitted of the charge of needlessly creating species and genera. Scudder's work on the contrary is open to no such accusation. It appears to me that in the present state of our knowledge of this group, species in themselves are of very little importance.

Whenever possible, therefore, I have avoided making them. The characters of the orders, families, and often of the genera are, on the contrary, of the highest interest. They show that the Pedipalpi, Araneæ and Ricinulei, and some of the Scorpiones have existed almost unchanged down to the present day; and that other Scorpions, on the other hand, *e. g. Eobuthus*, differed considerably from modern types in one feature at least, which may be described as Merostomatous. Apart from this one fact, and for a possibly closer connection between the spider named *Arthrolycosa* and the Amblypygous Pedipalpi than exists in modern types, these orders were as sharply defined as they are now; and unless, as is possible, the extinct orders, Haptopoda, Anthracomarti and Phalangiotarbi, serve to bridge to a certain extent the interval between the Opiliones and more primitive orders of Arachnida, it can hardly be claimed that the Carboniferous fauna throws much, if any, light upon the origin and mutual relationship of existing orders of the class. In other words, the available palæontological data supplied by a study of these Carboniferous Arachnida do not furnish any strong evidence in favour of the evolution of the class. Hence, for the common stock whence the Epectinate Arachnida originated, we must look to deposits much earlier than those laid down in the Carboniferous epoch.

II.—ANNOTATED REVISION OF PREVIOUSLY PROPOSED CLASSIFICATIONS OF CARBONIFEROUS ARACHNIDA.

1. Karsch, F. E., Zeitschr. deutsch. geol. Ges., 1882, pp. 556—561.

Order 1. ARANEÆ.
Family Liphistiidæ.
Genus **Protolycosa**, Roemer: *P. anthracophila*, Roemer.
Order 2. OPILIONES.
Family Trogulidæ.
Genus **Kreischeria**, Geinitz: *K. wiedei*, Geinitz.
Order 3. ANTHRACOMARTI.
Family Architarbidæ.
Genus **Architarbus**, Scudder: *A. rotundatus*, Scudder; *subovalis*, Woodward; *silesiacus*, Roemer.
Genus **Anthracomartus**, nov.: *A. völkelianus*, nov.
Family Eophrynidæ.
Genus **Eophrynus**, Woodward: *E. prestvicii*, Buckland.
Order 4. SCORPIONES.
Genus **Eoscorpius**, Meek and Worthen: *E. anglicus*, Woodward; *carbonarius*, Meek and Worthen.
Genus **Microlabis**, Corda: *M. sternbergi*, Corda.
Genus **Cyclophthalmus**, Corda: *C. senior*, Corda.
Genus **Mazonia**, Meek and Worthen: *M. woodiana*, Meek and Worthen.

Observations.—*Protolycosa* is very likely correctly referred to the Liphistiidæ. *Kreischeria* does not belong to the Trogulidæ of the order Opiliones, but is closely related to *Eophrynus*. The order Anthracomarti contains the elements of two orders; and the Architarbidæ the elements of two distinct families. The Architarbidæ, with *Architarbus*, should be eliminated from the Anthracomarti, and *Anthracomartus* left in the order as the type of a family—distinct from the Eophrynidæ.

2. Scudder, S. H., Proc. Amer. Acad. Arts and Sci., vol. xx, 1884, pp. 15—22.

Order ANTHRACOMARTI.
Family 1. Arthrolycosidæ.
Genus **Arthrolycosa**, Harger: *A. antiqua*, Harger.
Family 2. Poliocheridæ, nov.
Genus **Poliochera**, nov.: *P. punctulata*, sp. n.
Family 3. Architarbidæ.
Genus **Geraphrynus**, nov.: *G. carbonarius*, sp. n.
Genus **Architarbus**, Scudder: *A. rotundatus*, Scudder; *subovalis*, Woodward (= ? *Curculioides anstiĉii*, Buckland); *silesiacus*, Roemer.
Genus **Anthracomartus**, Karsch: *A. völkelianus*, Kusta; *krejcii*, Kusta; *trilobitus*, nov.; *pustulatus*, nov.
Family 4. Eophrynidæ.
Genus **Eophrynus**, Woodward: *E. prestvicii*, Buckland; *E. salmi*, Stur.
Order PEDIPALPI.
Genus **Geralinura**, nov.: *G. carbonaria*, sp. n.
Order SCORPIONES.
Family Eoscorpionidæ.
Genus **Eoscorpius**, Meek and Worthen: *E. carbonarius*, Meek and Worthen; *anglicus*, Woodward; *euglyptus*, *glaber*, *inflatus*, *tuberculatus*, Peach.
Genus **Cyclophthalmus**, Corda: *C. senior*, Corda (= *Microlabis sternbergi*).
Genus **Mazonia**, Meek and Worthen: *M. woodiana*, Meek and Worthen.
Order ARANEÆ.
Family Liphistiidæ.
Genus **Protolycosa**, Roemer: *P. anthracophila*, Roemer.
Genus **Palaranea**, Fritsch: *P. borassifolia*, Fritsch.

3. Scudder, S. H., Mem. Boston Soc. Nat. Hist., vol. iv, 1890, pp. 443—456.

Scudder's final classification of the American forms, omitting Araneæ and Scorpiones, was as follows:

Order ANTHRACOMARTI.
Family 1. Poliocheridæ.
Genus **Poliochera**, Scudder: *P. punctulata*, Scudder.

Family 2. ARCHITARBIDÆ.
Genus **Geraphrynus**, Scudder: *G. carbonarius*, Scudder.
Genus **Geratarbus**, nov.: *G. lacoei*; *scabrum*, spp. n.
Genus **Architarbus**, Scudder: *A. rotundatum*, Scudder; *elongatum*, sp. n.
Genus **Kustarachne**, nov.: *K. tenuipes*, sp n.
Genus **Anthracomartus**, Karsch: *A. trilobitus*, Scudder; *pustulatus*, Scudder.
Order PEDIPALPI.
Family GERALINURIDÆ.
Genus **Græophonus**, nov.: *G. carbonarius*, sp. n.
Genus **Geralinura**, Scudder: *G. carbonaria*, Scudder.

Observations.—In these classifications the order Anthracomarti contains heterogeneous elements belonging to the orders Araneæ (*Arthrolycosa*), Ricinulei (*Poliochera*), Anthracomarti (*Anthracomartus*), and, in my opinion, Phalangiotarbi (*Geraphrynus*, *Geratarbus*, *Architarbus*).

In the Pedipalpi the genera referred to the family Geralinuridæ belong to the very distinct sub-orders Amblypygi (*Græophonus*) and Uropygi (*Geralinura*).

4. HAASE, E., Zeitschr. deutsch. geol. Ges., 1890, pp. 629—657.

Order I. SCORPIONES.
Sub-order ANTHRACOSCORPII.
Family EOSCORPIONIDÆ.
Sub-families EOSCORPIONINI, CYCLOPHTHALMI.
Order II. PEDIPALPI.
Sub-order 1. *UROPYGI.*
Family THELYPHONIDÆ.
Genus **Geralinura**, Scudder: *G. carbonaria*, Scudder, etc.
Sub-order 2. *AMBLYPYGI.*
Family ARCHITARBIDÆ.
Genus **Architarbus**, Scudder: *A. rotundatus*, Scudder.
Genus **Geraphrynus**, Scudder: *G. carbonarius*, Scudder.
Order III. CHERNETES.
Genus **Rakovnicia**, Kusta: *R. antiqua*, Kusta.
Order IV. OPILIONES.
Sub-order 1. *PHALANGIOTARBI.*
Family PHALANGIOTARBIDÆ.
Genus **Phalangiotarbus**, nov.: *P. subovalis*, Woodward.
Sub-order 2. *ANTHRACOMARTI.*
Family ANTHRACOMARTIDÆ.
Genus **Anthracomartus**, Karsch: Many species.
Family KREISCHERIIDÆ.
Genus **Kreischeria**, Geinitz: *K. wiedei*, Geinitz.
Family EOPHRYNIDÆ.
Genus **Eophrynus**, Woodward: *E. prestvicii*, Buckland; *salmi*, Stur; *sturii*, sp. n.

Sub-order 3. *PLAGIOSTETHI.*
Family TROGULIDÆ.
Genus **Poliochera**, Scudder.
Order V. ARANEÆ.
Sub-order 1. *ARTHRARACHNÆ.*
Family ARTHROLYCOSIDÆ.
Genera **Arthrolycosa**, Harger; **Geralycosa**, Kusta.
Sub-order 2. *TETRASTICTA* (*TETRAPNEUMONES*).
Family PROTOLYCOSIDÆ.
Genus **Protolycosa**, Roemer.
Family LIPHISTIIDÆ.
Genera **Eolycosa**, Kusta; **Palaranea**, Fritsch.

Observations.—Haase makes the great advance of recognising the close affinity between the genera he refers to the sub-order Anthracomarti. But *Poliochera* does not belong to the Opiliones, nor in my opinion can the Anthracomarti and Phalangiotarbi be relegated to that order. It seems to me, moreover, that the Phalangiotarbidæ and Architarbidæ belong to the same ordinal group, for which I adopt Haase's name Phalangiotarbi; and this order has no near relationship with the Pedipalpi of the sub-order Amblypygi. As regards the Araneæ, it appears to me that of all the Carboniferous forms *Arthrolycosa* is the most nearly allied to the existing *Liphistius*, and I cannot find any evidence in favour of the creation of a sub-order Arthrarachnæ for *Arthrolycosa* and *Geralycosa;* nor does it appear to me that *Protolycosa*, *Eolycosa*, and *Palaranea* can be referred with any certainty to the Tetrapneumones, none of the existing members of which retain the terga of the opisthosoma.

5. POCOCK, R. I., Geol. Mag. [4], vol. ix, 1902, pp. 439—448, 487—493; and vol. x. 1903, p. 408.

Order ANTHRACOMARTI.
Family ANTHRACOSIRONIDÆ.
Genus **Anthracosiro**, nov.: *A. woodwardi*, nov.; *fritschii*, nov.
Family ANTHRACOMARTIDÆ.
Genus **Anthracomartus**, Karsch.
Genus **Brachypyge**, Woodward: *B. carbonis*, Woodward; *celtica*, nov.
Family EOPHRYNIDÆ.
Genus **Eophrynus**, Woodward: *E. prestvicii*, Buckland; *salmi*, Stur; *sturii*, Haase.
Genus **Kreischeria**, Geinitz: *K. wiedei*, Geinitz.

6. MELANDER, A. L., Journ. Geol. (Chicago), vol. ii, 1903, pp. 178—184, pls. v, vii.

The author of this paper follows Scudder's classification, and evidently has a very limited acquaintance with Arachnid morphology. He attempts a tabulation

of the genera of the Carboniferous Arachnida of Illinois, adding to those previously characterised a new genus and species, *Hadrachne horribilis*, which certainly belongs to the Phalangiotarbi as defined below.

7. Fritsch, A., Palæozoische Arachniden, Prag, 1904, pp. 5—80.

Order ARANEÆ.
Sub-order ARTHRARACHNÆ, Haase.
Family Arthrolycosidæ.
Genus **Arthrolycosa**, Harger: *A. antiqua*, Harger, etc.
Genus **Protolycosa**, Roemer: *P. anthracophila*, Roemer.
Genus **Geralycosa**, Kusta: *G. fritschii*, Kusta.
Genus **Rakovnicia**, Kusta (= *Eotarbus*, Kusta): *R. antiqua*, Kusta.
Sub-order PLEURARANEÆ, nov.
Family Hemiphrynidæ.
Genus **Hemiphrynus**, Fritsch: *H. longipes, hofmanni*, Fritsch.
Family Promygalidæ.
Genus **Promygale**, Fritsch: *P. bohemica*, Fritsch, etc.
Genus **Perneria**, Fritsch: *P. salticoides*, Fritsch.
Genus **Eopholcus**, Fritsch: *E. pedatus*, Fritsch.
Genus **Pleurolycosa**, Fritsch: *P. prolifera*, Fritsch.
Genus **Brachylycosa**, Fritsch: *B. carcinoides*, Fritsch.
Genus **Pyritaranea**, Fritsch: *P. tubifera*, Fritsch.
Order OPILIONES.
Sub-order OPILIONIDÆ VERI.
Genus **Nemastomoides**, Thevenin: *N. elaveris*, Thevenin.
Genus **Dinopilio**, Fritsch: *D. gigas*, Fritsch.
Sub-order MERIDOGASTRA (= *ANTHRACOMARTI*).
Family Poliocheridæ.
Genus **Poliochera**, Scudder: *P. punctulata*, Scudder.
Family Architarbidæ.
Genus **Geraphrynus**, Scudder: *G. carbonarius, elongatus*, Scudder.
Genus **Architarbus**, Scudder: *A. rotundatus*, Scudder; *subovalis*, Woodward.
Family Anthracomartidæ.
Genus **Anthracomartus**, Karsch: Several species.
Genus **Brachypyge**, Woodward: *B. carbonis*, Woodward; *celtica*, Pocock.
Genus **Anthracosiro**, Pocock: *A. woodwardi, fritschii*, Pocock.
Genus **Eotrogulus**, Thevenin: *E. fayoli*, Thevenin.
Genus **Vratislavia**, Fritsch: *V. silesiaca*, Roemer.
Family Eophrynidæ.
Genus **Eophrynus**, Woodward: *E. prestvicii*, Buckland.
Genus **Stenotrogulus**, Fritsch: *S. salmi*, Stur.
Genus **Cyclotrogulus**, Fritsch: *C. sturii*, Haase.
Genus **Kreischeria**, Geinitz: *K. wiedei*, Geinitz.
Genus **Hemikreischeria**: *H. geinitzi*, Thevenin (= *thevenini*, Fritsch).
Genus **Petrovicia**, Fritsch: *P. proditoria*, Fritsch.
Genus **Adelocaris**, Packard: *A. peruvianus*, Packard.

Order PEDIPALPI.

Family THELYPHONIDÆ.

Genus **Prothelyphonus**, Fritsch: *P. bohemicus*, Kusta; ? *cordai*, Fritsch.

Genus (**Geralinura**, Scudder).

Order SCORPIONES.

Sub-order ***DIONYCHOPODES.***

Family ANTHRACOSCORPII.

Genus **Cyclophthalmus**, Corda: *C. senior*, Corda.

Genus **Microlabis**, Corda: *M. sternbergi*, Corda.

Genus **Isobuthus**, Fritsch: *I. kralupensis*, Thorell and Lindström.

Genus **Eobuthus**, Fritsch: *E. rakovnicensis*, Fritsch.

Genus **Feistmantelia**, Fritsch: *F. ornata*, Fritsch.

Genus **Eoscorpius**, Meek and Worthen: *E. carbonarius*, Meek and Worthen; *anglicus*, Woodward.

Genus **Mazonia**, Meek and Worthen: *M. woodiana*, Meek and Worthen.

Observations.—For reasons published in 1910 I consider that Fritsch's genus *Promygale* is a synonym of *Anthracomartus*; and since the forms he refers to *Hemiphrynus* also belong apparently to the same order as *Anthracomartus*, there is no reason for the retention of his suborder Pleuraraneæ. At all events, whatever these forms may be, they are assuredly not referable to the Araneæ. The other genera assigned to the Araneæ seem to belong to that order, so far as can be judged from the author's figures. As for his order Opiliones, it has already been stated that the Poliocheridæ, Architarbidæ, Anthracomartidæ and Eophrynidæ cannot be relegated to it nor to any single group of Arachnida, whether it be named Anthracomarti or Meridogastra. *Nemastomoides* may be one of the Opiliones, but *Dinopilio*, if figured with an approach to accuracy, should find place in the Araneæ probably. In recognising that *Geraphrynus* and *Architarbus* (including *Phalangiotarbus*) constitute a natural group, Fritsch improves upon Haase's system. As regards the Anthracomartidæ and Eophrynidæ, he practically follows my classification, although he places *Anthracosiro* in the Anthracomartidæ and by so doing drops the family Anthracosironidæ.

Unfortunately, the value of this monograph is lessened by the author's lack of acquaintance with the morphology of recent Arachnida, especially on such points as the constancy of the segmentation of the appendages within ordinal limits. His restorations, therefore, cannot be regarded as correct interpretations of the structure of the fossils.

8. POCOCK, R. I., Geol. Mag. [5], vol. vii, 1910, pp. 505—512.

Reasons are given for concluding that the genera referred by Fritsch to the Pleuraraneæ belong to the Anthracomarti, *Promygale* being a synonym of *Anthracomartus*.

The Phalangiotarbi are retained as a valid group containing the following families and genera with their type species:

Family PHALANGIOTARBIDÆ.
Genus **Phalangiotarbus**, Haase: *P. subovalis*, Woodward.
Family ARCHITARBIDÆ.
Genus **Architarbus**, Scudder: *A. rotundatus*, Scudder.
Genus **Geraphrynus**, Scudder: *G. carbonarius*, Scudder.
Genus **Geratarbus**, Scudder: *G. lacoei*, Scudder.
Genus **Opiliotarbus**, nov.: *O. elongatus*, Scudder.

III.—SYSTEMATIC ACCOUNT OF THE BRITISH SPECIES.

Order SCORPIONES, Latreille.

The Carboniferous Scorpions were formerly assigned by Thorell and Lindström to a special group, Anthracoscorpii, on the supposition that the median eyes were in advance of the lateral eyes, instead of behind them as in recent Scorpions or Neoscorpii. This supposition has no foundation in fact, so far as is known. Perhaps, indeed, the most useful contribution that Fritsch has made to our knowledge of fossil Scorpions, is his discovery that the so-called posterior row of eyes described by Corda in *Cyclophthalmus senior* are in reality tubercles. Fritsch, however, still preserved the name Anthracoscorpii for the Carboniferous species collectively, although justification for this course was not supported by any new definition of the group.

Nevertheless, some of the Carboniferous Scorpions differ from all recent forms in one or two characters of great morphological interest. In the specimen described below from the Coal Measures of Sparth, belonging to the collection of Mr. F. Holt, the sterna of the fourth, fifth, and sixth segments of the opisthosoma end posteriorly in a pair of widely rounded laminate lobes, which are separated by a median angular notch and manifestly overlap the anterior portion of the sterna that succeed them. I am unable to say whether the sternum of the third was similarly constructed; possibly not, since it was evidently covered to a great extent by the pectines of the second sternal plate, which was of large size—much larger, indeed, than in any recent species. Moreover, the basal segments of the legs of the fourth pair do not apparently abut against the sternal plate of the prosoma, as in existing Scorpions, but against the sides of the genital operculum, a feature quite unknown in existing species, in which the coxæ of the third and fourth legs are united to form a wedge-shaped skeletal piece diverging obliquely backwards and outwards from the sternum of the prosoma. The figures published by Fritsch of the types of *Eobuthus rakovnicensis* and of *Isobuthus kralupensis* seem to agree

with Mr. Holt's example in the mode of attachment of the coxæ in question; but even if in these specimens the sclerites on each side of the genital operculum do not, as figured by Fritsch, belong to the fourth leg, the presence of sclerites on each side of this plate is a feature unknown in modern Scorpions, where the operculum is the sole trace of appendages of the first segment of the opisthosoma. These sclerites, therefore, are of great morphological interest, whatever interpretation be put upon them. It is possible, indeed, that they must be compared with the lateral plates of the genital segment present apparently in the Silurian Scorpion I described as *Palæophonus hunteri*[1] (Quart. Journ. Micr. Sci., 1902, p. 291, pl. 19).

The peculiarities above described do not, however, exist in all Carboniferous Scorpions. In one of the specimens described below under the heading *Anthracoscorpio buthiformis* the sternum of the prosoma, the coxæ of the third and fourth legs, and the genital operculum appear to be in structural agreement with the same pieces in recent Scorpions; and there is no evidence that they are differently arranged in the example in the British Museum which I identify as *Anthracoscorpio sparthensis*. The species described by Peach as *Eoscorpius euglyptus* and *glaber* also seem to fall into line with recent types in the particulars named; and Fritsch's figure of *Cyclophthalmus senior* is susceptible of the same interpretation.

Hence it seems that the Carboniferous Scorpions are divisible into two groups, one of which is inseparable on broad structural lines from recent species. The terms "Anthracoscorpii" and "Neoscorpii" cease, therefore, to be applicable. Although it is impossible to assign all the described Carboniferous species to one or the other of these groups, it appears to me that the characters by which the two are distinguished are too important and interesting to be ignored in a classification of this order. I propose, therefore, the term **Lobosterni** for those with bilobed, posteriorly-laminate sternal plates on the opisthosoma and skeletal plates, whether belonging to the fourth leg or not, on each side of the genital operculum; and the term **Orthosterni** for those agreeing apparently with recent Scorpions in the structure of the plates in question. In this monograph *Eobuthus* belongs to the Lobosterni, and *Cyclophthalmus*, *Archæoctonus* and *Anthracoscorpio* to the Orthosterni, *Palæomachus* being of doubtful position. Of exotic genera, *Microlabis* seems to be referable to the Orthosterni, *Isobuthus* to the Lobosterni, while *Eoscorpius* and *Mazonia* cannot be classified. Probably a special group should be created for *Mazonia* if the extant restoration of the genus be accurate.

The determination of the genera has been a matter of great difficulty, because I have been compelled to rely mostly upon the figures and descriptions published by Fritsch, whose acquaintance with the morphology of recent Scorpions is

[1] According to Mr. R. Dunlop (Ann. Glenfield Rambler, No. 2, 1898, pp. 60—64) this Silurian Scorpion was named *Palæophonus caledonicus* by Dr. Peach. I do not know where Dr. Peach described it under that name; and possibly Mr. Dunlop, writing from memory, has confused this species with *Glyptoscorpius caledonicus*. Provisionally, therefore, I retain *hunteri* as the specific designation.

evidently not sufficiently intimate to inspire confidence in the accuracy of his interpretations of the fossils. This fact, coupled with the imperfect preservation of many specimens, makes the classification of the British species, put forward in the following monograph, provisional in many respects. I hope, at least, that it may help those who come after me to improve upon the system here proposed.

All the British species of Carboniferous Scorpions hitherto described have been referred to the genus *Eoscorpius*, Meek and Worthen, which was based upon a single species, *E. carbonarius*, from Mazon Creek, Illinois (Amer. Journ. Sci., ser. 2, vol xlv, 1868, p. 560). The chelæ are unknown; but the last tergal plate of the abdominal portion of the opisthosoma is of quite unusual length as compared with the other terga and with the carapace, which appears to be short. The second and third caudal segments, moreover, are long, being much longer than wide, suggesting that the entire tail must have been at least four times, and was very probably five times, as long as the carapace. Since none of the British species in which these skeletal pieces are known, agree with *Eoscorpius carbonarius*, they cannot be assigned to the genus. Scudder has suggested that *Mazonia woodiana*, from the same beds as *Eoscorpius carbonarius*, may be synonymous with it. This view, however, cannot on the evidence be entertained; because, if correctly drawn, the former is unique in having either a segmented carapace or eight dorsal shields, possibly, indeed, nine, according to Fritsch, between the head-shield and the tail. The ocular tubercle, moreover, is situated almost at the anterior border of the carapace, and the humerus and brachium of the chela are remarkably long and slender. Since none of the British species present these characters, *Mazonia*, like *Eoscorpius*, need not be further considered in this monograph.

The European species, excluding those described by Dr. Peach from Scotland which are omitted from Fritsch's monograph, are referred by this author to the following genera: *Cyclophthalmus*, Corda; *Microlabis*, Corda; *Isobuthus*, Fritsch; *Eobuthus*, Fritsch; *Feistmantelia*, Fritsch; and *Eoscorpius*, M. and W. *Anthracoscorpio*, Kusta, is rejected by Fritsch as based upon an immature specimen of *Eobuthus*; and *Eoscorpius* is included for the reception of the species described by Dr. Woodward as *E. anglicus*.

Microlabis, possessing only one species, namely, *M. sternbergi*, Corda, differs from all the other European genera, so far as is known, in the structure of the chelæ, which have the brachium long, parallel-sided, and prismatic, the hand or manus short and very narrow, without any bulge on its inner edge, and with no concavity at the base of the immovable digit, which, like the movable, is long, stout, and straight, the two resembling the blades of scissors, the movable being more than half as wide as the hand. This genus, therefore, may be set on one side. So also must *Feistmantelia*, based upon a single character, the tuberculation of the pectines. This is probably the same feature as that described by Dr. Peach

in several Scottish species, referable to more than one genus, as "embossed scale-like pattern." It is not known whether *Cyclophthalmus* possessed this character or not.

A glance at Peach's figures of Scottish Carboniferous Scorpions shows that at least two genera must be admitted. One of the species, described as *Eoscorpius euglyptus*, has the large cheliceræ and stout chelæ of *Cyclophthalmus*, and I am unable to say that it does not belong to that genus. *Eoscorpius glaber*, on the contrary, is a totally different form; and it also differs in the shortness of its legs and the structure of its chelæ from all the other European genera where these organs are known. For this I propose a new generic name, *Archæoctonus*. A third British genus seems to be represented by the species described as *Eoscorpius anglicus* by Dr. Henry Woodward. The remaining British species are, for reasons discussed below, assigned to the genera *Anthracoscorpio*, Kusta, and *Eobuthus*, Fritsch.

The subjoined table shows the main features by which these genera may be tentatively distinguished from each other:

a. Hand of chelæ wide and oval, greatly exceeding the brachium in width; fingers very short, the movable about equal to the width of the hand. [Caudal segments apparently very short and broad and not sensibly increasing in length posteriorly; legs and sterna unknown.] . . . . . *Palæomachus.*

a'. Hand of chelæ wide or narrow, but at most only exceeding by a little the width of the brachium; fingers, except perhaps in *Eobuthus*, long, the movable much longer than the width of the hand.

b. Legs exceedingly short, the fourth, when extended, not reaching the end of the abdominal portion of the opisthosoma; its femur much shorter than the carapace. [Sterna of abdomen with straight posterior borders; coxæ of third and fourth legs apparently abutting against the sternum of the prosoma.] . . . . . *Archæoctonus.*

b'. Legs of normal length, the fourth, when extended, surpassing the posterior end of the abdomen; its femur about as long as the carapace.

c. Coxæ of third and fourth legs abutting against the sternum of the prosoma; the posterior border of the sterna of the fourth, fifth, and sixth segments of the opisthosoma straight or nearly so.

d. Chelæ heavy and massive, with stout, strong fingers. *Cyclophthalmus.*

d'. Chelæ comparatively light and slender, with thin fingers. *Anthracoscorpio.*

c. Coxæ of legs of third pair abutting against the sternum of the prosoma, those of the fourth against the genital operculum; sterna of fourth, fifth, and sixth segments of opisthosoma markedly bilobate and laminate posteriorly. . . . *Eobuthus.*

Genus **EOBUTHUS**, Fritsch.

1904. *Eobuthus*, A. Fritsch, Palæoz. Arachn., p. 72 (in part).

This genus was based by Fritsch on two Carboniferous Scorpions from Bohemia, one in the museum at Prague, the other in the British Museum. Both were named *E. rakovnicensis*. The specimen at Prague I have not seen; but if Fritsch's restoration of it approaches accuracy, the fossil cannot be assigned to the same genus as that in the British Museum. One great difference between them lies in the structure of the chelæ, the movable digit in the Prague specimen being much shorter than the length of the hand or manus, and only a little exceeding its breadth,whereas in the British Museum specimen the length of the movable digit greatly exceeds both the length and breadth of the hand. Moreover, the structure of the sternal surface of the prosoma in the Prague specimen is quite abnormal in the circumstance, that the coxæ of the legs of the last pair appear to abut against the genital operculum, those of the third pair alone running up to the sternal plate of the prosoma. In the British Museum specimen, on the contrary, so far as I can judge, the coxæ of these appendages are quite normal in their mode of attachment to the body. This specimen, in fact, appears to be a normal Scorpion in every respect, except that the sternal plates of the fifth and sixth segments of the opisthosoma are seemingly slightly lobate posteriorly with a shallow median notch.

Since the diagnosis of *Eobuthus* was taken, mainly, at all events, from the specimen at Prague, I propose to regard that specimen as the type of *E. rakovnicensis*. Different names, both generic and specific, must therefore be found for the example in the British Museum.

According to Fritsch the generic name *Anthracoscorpio* was given by Kusta to a Scorpion named *A. juvenis*, which is the young of *Eobuthus rakovnicensis*. If this be so Fritsch had no right, according to the accepted rules of nomenclature, to assign new generic and specific names to the fossils in question. But the figure he published of the type of *Anthracoscorpio juvenis* cannot, according to his interpretations, represent the young of the typical *Eobuthus rakovnicensis* as here understood. It may, however, represent the young of the form in the British Museum. At all events the two specimens are likely enough to be congeneric. I propose, therefore, to assign the specimen in the British Museum to the genus *Anthracoscorpio*; and since I cannot, on the available evidence, separate this specimen specifically from the type of *Eoscorpius sparthensis* (*cf. infra*, p. 20), it may take for the time being the name *Anthracoscorpio sparthensis*.

I have seen only one British Scorpion which appears to agree with the type of *Eobuthus rakovnicensis* in the mode of attachment of the posterior limbs to the body. This I propose to name as follows:

Eobuthus holti, sp. nov. Plate II, fig. 2; Text-figure 1.

The sternum of the prosoma is semi-elliptical, convex, rounded in front and truncated behind. Abutting against it on each side there is a large coxal segment belonging to the legs of the third or fourth pairs. Following the sternum there is a conspicuous bivalved genital operculum resembling in a general way that of recent Scorpions; and on each side of this there appears to be a segment (or segments) of a limb, which does not, however, resemble the coxa of the fourth leg in recent Scorpions, which always abuts against the sternum of the prosoma. If it does not belong to the fourth leg, I can only suggest that it represents the external ramus of a pair of appendages belonging to the genital segment, the

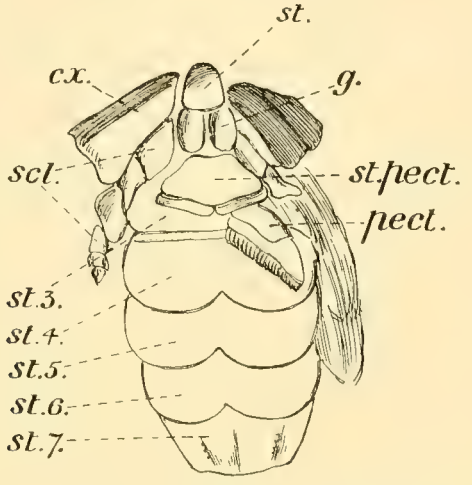


Fig. 1.—*Eobuthus holti*, sp. n.; partially restored and slightly magnified from the type specimen.—Coal Measures; Sparth, near Rochdale. F. Holt Collection. *cx.*, coxa of 3rd leg, possibly fused coxæ of 3rd and 4th legs; *g.*, genital operculum; *pect.*, one of the pectines, its exact structure being doubtful; *scl.*, sclerites abutting against genital operculum and probably representing either the basal segments of a leg of the 4th pair or the lateral ramus of the appendage of the 1st somite of the opisthosoma; *st.*, sternum of prosoma; *st. pect.*, sternum of pectinal somite; *st.* 3 to *st.* 7, st rna of the 3rd to the 7th somites of the opisthosoma, the exact shape of the 3rd being doubtful.

two halves of the genital operculum being the internal rami. In this connection it must be remembered that the genital operculum of *Limulus polyphemus* consists of a pair of inner and a pair of outer branches or rami. Behind the genital operculum follows a moderately large plate, much wider behind than in front. This is the sternum to which the pectines are attached. One of the latter attached to its posterior border is traceable, but the details of its structure, apart from its shape and the presence of numerous small teeth, are too faint to figure or describe with assurance.

Of the five posterior sterna of the abdominal portion of the opisthosoma, the first appears to be rather small and to be overlapped by the sternum and pectines of the segment in front of it. I cannot find evidence that its posterior border is bilobed; but the posterior borders of the three succeeding sterna are markedly

laminate and bilobed; the lobes are semicircular and considerably overlap the anterior portion of the sterna behind them. No such laminate lobes are found on the last sternal plate of the abdominal portion of the opisthosoma; this sternum is exactly like that of recent Scorpions and has a pair of abbreviated granular crests. The interest of these laminate lobes on the sterna which belong morphologically to the fourth, fifth and sixth segments of the opisthosoma, lies in their general resemblance to the gill-bearing appendages of the same segments in *Limulus*. I can find no trace of stigmata upon these sterna; hence I suppose that the respiratory lamellæ lay beneath them as they do in *Limulus*. In possessing these lobate sternal plates, the Scorpion now described is more like *Limulus* than is the Silurian Scorpion *Palæophonus*; and it supplies one more valuable link in the chain of evidence pointing to affinity between the Scorpions and Xiphosuræ.

The fragments of limbs of the prosoma that remain resemble those of recent Scorpions, and offer nothing specially worthy of comment.

Measurements in mm.—Total length from anterior end of sternum of prosoma to posterior end of last abdominal segment of opisthosoma about 41; length of coxa abutting against sternum 11; length of the sternum 4, width about 3·5; width of genital operculum 4·5, length 3·5; length of sternum of pectinal segment 4, anterior width 4, posterior width 9·5; length of pecten about 9; width of penultimate sternal plate of abdomen 21; length at the side nearly 9.

A single specimen from Sparth, near Rochdale, in the collection of Mr. F. Holt.

This specimen shows the ventral surface of the abdominal portion of the opisthosoma, part of the ventral surface of the prosoma, and portions of some of the limbs.

So far as can be judged, this specimen differs from that of *E. rakovnicensis* in being larger and in having the sternal plate of the pecten-bearing segment relatively much larger. In *E. rakovnicensis* the length from the sternum of the prosoma to the end of the abdominal portion of the opisthosoma is probably about 34 mm. In *E. holti*, the same area, although contracted, is 41 mm.; and in the latter the length of the sternum of the prosoma is about equal to that of the sternal plate of the pectines, while it is much less than half its posterior width. In *E. rakovnicensis*, on the contrary, the sternum of the prosoma is longer than the sternum of the pectines and half its posterior width. I have no doubt that many more differences will be discovered when better material is available for examination.

I provisionally refer to this species a specimen from the Shipley claypit in Dr. Moysey's collection. It consists of the abdominal portion of the opisthosoma, showing the terga, some of the sterna, and a considerable portion of one of the legs of the last pair. The segments, however, are apparently telescoped to a considerable extent, thus appearing to be very much shorter than they are in reality. The tergum and sternum of the last segment of the abdominal portion

are wonderfully well preserved. The tergum bears many scattered coarse granules, has coarsely granular lateral margins, and a pair of coarsely granular longitudinal keels lying slightly obliquely, each keel being rather nearer to the lateral edge than to its fellow of the opposite side; the sternum, on the other hand, is smooth except for two coarsely granular longitudinal keels, one on each side of the middle line. The sterna in front of this are not sufficiently well preserved for me to state definitely that they were laminate and lobate posteriorly as in Mr. Holt's specimen, but there are indications that this was so.

Measurements in mm.—Total length of abdominal portion of opisthosoma (contracted) 28; width of the same (distended) 22; width of tergum of the last segment 17, of sternum 20; length of femur of fourth leg 13, of patella 11, of tibia 11.

According to Fritsch's restoration, the type of *Isobuthus*, *I. kralupensis*, Thorell and Lindström, resembles *Eobuthus rakovnicensis* in the mode of attachment of the coxæ of the legs of the third and fourth pairs to the body. It also appears to have the posterior margin of the sterna of the fourth, fifth and sixth segments of the opisthosoma bilobate and mesially notched, as in Mr. Holt's specimen described above. On the evidence, therefore, *Isobuthus* must be assigned to the same group of Scorpions as *Eobuthus;* but according to the figures published by Fritsch, *Isobuthus* has tolerably normal chelæ with the movable finger greatly exceeding in length both the length and breadth of the hand. Since the chelæ are unknown in Mr. Holt's specimen, it is possible that the species it represents may be congeneric with *Isobuthus kralupensis*.

Genus **PALÆOMACHUS**, nov.

1876. *Eoscorpius*, H. Woodward (in part), Quart. Journ. Geol. Soc., vol. xxxii, p. 58, pl. viii.

Generic Characters.—Hand broad and oval, its width greatly exceeding that of the brachium, its length exceeding that of the fingers, which are short and in contact when closed, the length of the immovable digit about equal to the width of the hand. Caudal segments short and stout, apparently about as long as they are wide or high, and not progressively increasing in length from the base to the tip of the tail.

Type Species.—*Eoscorpius anglicus*, H. Woodward.

Palæomachus anglicus (H. Woodward). Text-figure 2.

1876. *Eoscorpius anglicus*, H. Woodward, Quart. Journ. Geol. Soc., vol. xxxii, p. 58, pl. viii, fig. 3 (type), also t gs. 1 and 2.

The type species of this genus was based upon three specimens, namely, the extremity of a chela from Mansfield in Nottinghamshire, five caudal segments

from the same locality and horizon, and an entire tail from the Sandwell Park Colliery, Birmingham. It is not unlikely that the tail from Mansfield belonged to an example of the same species as the owner of the chela, from the same locality; and this tail is structurally closely similar to the one from Birmingham. Dr. Woodward, therefore, was perfectly justified in referring the three to the same species. In this I propose to follow his example until evidence to the contrary is forthcoming. Nevertheless, in view of the possibility of the chela and caudal segments from Mansfield belonging to different species, perhaps to different genera, it seems advisable to select one of the specimens as the type of the species. I select, therefore, the chela, because the species may be distinguished at once from all other Carboniferous Scorpions in which the chela is known, by the shape and proportions of the segments of this appendage.

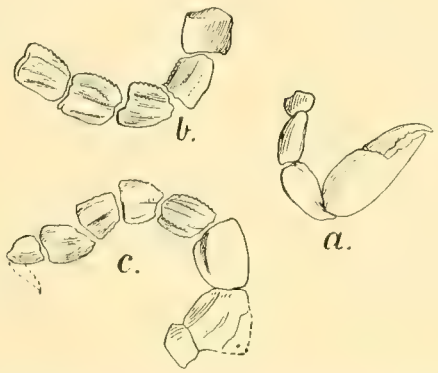


Fig. 2.—*Palæomachus anglicus* (Woodward); copied from Quart. Journ. Geol. Soc., vol. xxxii, pl. viii. *a.*, chela from Mansfield; *b.*, five caudal segments from Mansfield; *c.*, entire tail from Sandwell Park.

The only Carboniferous Scorpion described with fingers as short as in *P. anglicus* is the type of *Eobuthus rakovnicensis*, Fritsch. Assuming that the figure and description published by Fritsch are correct, *P. anglicus* cannot be assigned to the genus *Eobuthus*, because in the type species of the latter the hands are much longer than the digits, and a little narrower than the brachium.

Genus **ARCHÆOCTONUS**, nov.

1883. *Eoscorpius*, Peach (in part), Trans. Roy. Soc. Edinb., vol. xxx, p. 398.

Generic Characters.—Distinguishable, so far as is known, from all other genera of Carboniferous, as well as of recent Scorpions, by the extreme shortness of the legs, those of the fourth pair, when extended, not nearly attaining the posterior extremity of the abdominal portion of the opisthosoma (pre-abdomen). The individual segments of the legs are not very unequal in length, and the femur of the fourth is much shorter than the carapace. The hand of the chela is small,

narrow, scarcely at all inflated, about the width of the preceding segment (brachium), and the back of the hand is only about half the length of the movable digit; the digits are straight and in contact when closed, and the immovable is markedly bent at the tip.

Type Species.—*Eoscorpius glaber*, Peach.

In the structure of its post-oral appendages this Scorpion is very peculiar. Judging from Peach's figure the chelæ differ structurally from those of all known species, living or extinct, especially in the straightness of the fingers, the narrow, nearly parallel-sided, but short hand, and the extreme shortness of the brachium. The possibility of Peach having made a mistake over this last feature in his restoration has influenced my decision to leave it out of the diagnosis. It must not, however, on that account be forgotten, as might well be the case seeing that no mention of the peculiarity is to be found in the text. Nor was the author

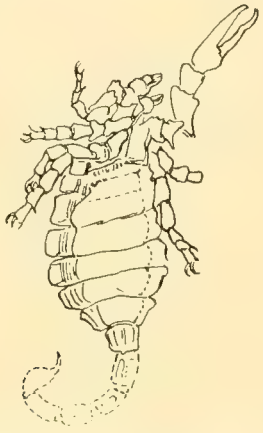


Fig. 3.—*Archæoctonus glaber* (Peach); copied from Trans. Roy. Soc. Edinb., vol. xxx, pl. xxii, fig. 2 *b*, nat. size.—Lower Carboniferous; Langholm. A. Macconochie Collection.

struck, apparently, by the anomalous structure of the ambulatory limbs, which his drawings show so well. Another interesting feature not referred to is the presence of a single pedal spur on the terminal joint of the legs, a feature in which this Scorpion resembles the genera belonging to the existing family Scorpionidæ.

Archæoctonus glaber (Peach). Text-figure 3.

1883. *Eoscorpius glaber*, B. N. Peach, Trans. Roy. Soc. Edinb., vol. xxx, p. 400, pl. xxii, figs. 2—2 *l*.

Integument smooth, without tubercles. Total length probably about 50 mm., carapace 9 mm., last abdominal + first caudal segment 7 mm., movable digit 8 mm., back of hand 3 mm., width of hand 4 mm., of brachium 3 mm.

Based on two specimens, the type from near the Cementstone Group of the Lower Carboniferous, Langholm, Dumfriesshire, the other from the Calciferous Sandstone Series at Redhall, near Slateford, Edinburgh.

Archæoctonus tuberculatus (Peach).

1883. *Eoscorpius tuberculatus*, B. N. Peach, Trans. Roy. Soc. Edinb., vol. xxx, p. 398, pl. xxiii, figs. 8—8 *h*.

Possibly not belonging to the genus *Archæoctonus*, since the ambulatory appendages are unknown and the chelæ unfigured and indifferently described. Specifically *A. tuberculatus* differs from *A. glaber* in having the terga of the abdominal portion dotted with small tubercles, and ornamented with two rows of larger tubercles along the posterior margin.

Total length supposed to be about 62 mm.

This species was based upon several pieces obtained from the Coal Measures at Blair Point, near Dysart, and from the Calciferous Sandstone Series from Redhall and Cramond, near Edinburgh.

Genus **CYCLOPHTHALMUS**, Corda.

1835. *Cyclophthalmus*, A. J. C. Corda, Verh. Ges. Mus. Böhm., p. 36.
1904. *Cyclophthalmus*, A. Fritsch, Palæoz. Arachn., pp. 65—68.

For reasons already given (p. 12) this genus is here recorded for the reception of the Scorpion described by Peach as *Eoscorpius euglyptus*.

Cyclophthalmus euglyptus (Peach). Text-figure 4.

1883. *Eoscorpius euglyptus*, B. N. Peach, Trans. Roy. Soc. Edinb., vol. xxx, pp. 402—404, pl. xxii, figs. 3 to 3 *d*.

This species was based on a single specimen obtained near the base of the Cementstone Group, Calciferous Sandstone (Lower Carboniferous), near Langholm, Dumfriesshire, in Scotland. The ventral surface of the prosoma, with complete cheliceræ and chelæ and incomplete walking legs, is exposed, the structure of the coxæ, sternum, genital operculum and pectines being well shown.

The cheliceræ and chelæ are large, the chelæ being heavy and massive; the hand is ovally elongate in profile view, considerably longer than wide, and a little wider than the brachium; the fingers are arcuate and basally lobate, the movable being but little longer than the back of the hand. The sternum is pentagonal; the pectines are large and ornamented with squamiform sculpture.

Judging from Peach's restoration the measurements in mm. of the chelæ are as follows:

Length of humerus 13, of brachium 11, of back of hand 12, of movable finger 12·5; width of hand 7·5, of brachium 7.

C. senior, the type of the genus *Cyclophthalmus*, certainly differs from *C. euglyptus* in having the hand shorter, the movable digit being much longer than the back of the hand. So far as size is concerned, the two Scorpions are much alike.

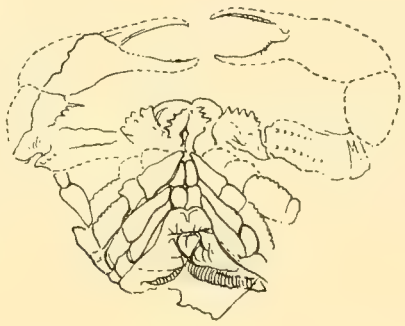


Fig. 4.—*Cyclophthalmus euglyptus* (Peach); copied from Trans. Roy. Soc. Edin., vol. xxx, pl. xxii, fig. 3 *a*, nat. size.—Lower Carboniferous; Langholm. A. Macconochie Collection.

The length of *C. senior*, without the tail, is about 44 mm.; with the tail it would be probably between 80 and 90 mm.

Genus **ANTHRACOSCORPIO**, Kusta.

1888. *Anthracoscorpio*, J. Kusta, SB. k. böhm. Ges. Wiss., p. 202.
1904. *Anthracoscorpio*, A. Fritsch, Palæoz. Arachn., p. 75.
1904. *Eobuthus*, A. Fritsch, Palæoz. Arachn., p. 72 (in part).
1904. *Eoscorpius*, W. Baldwin and W. H. Sutcliffe, Quart. Journ. Geol. Soc., vol. lx, pp. 395—398.

Characters as enumerated above (p. 12).

Anthracoscorpio sparthensis (Baldwin and Sutcliffe).

1904. *Eobuthus rakovnicensis*, A. Fritsch, Palæoz. Arachn., p. 74, text-fig. 91, and pl. xii, figs. 1—3 (*nec* text-figs. 90 and 92, and pl. xii, figs. 1 and 2).
1904. *Eoscorpius sparthensis*, W. Baldwin and W. H. Sutcliffe, Quart. Journ. Geol. Soc., vol. lx, p. 396, fig. 2.

Messrs. Baldwin and Sutcliffe appear to have compared the type of *A. sparthensis* with the example in the British Museum described by Fritsch as *Eobuthus rakovnicensis*. On the evidence I do not agree that the two specimens can be regarded as specifically distinct; nevertheless, for reasons given above

(p. 13) the name *sparthensis* must be retained. The characters relied upon for separating *sparthensis* as a distinct species are : (1) A difference of 1 mm. in total length; (2) a shorter and narrower abdomen; (3) shorter caudal segments; (4) a narrower hand.

Since Scorpions vary in size both individually when adult and according to age, the first character clearly has no value. The second may be similarly dismissed because the length and girth of the abdomen vary enormously in accordance with the degree of repletion of this region with food or embryos; it is usually, moreover, narrower and shorter in males than in females. The third character appears to me to have no foundation in fact, so far as I can judge from the rough sketch of the type of *E. sparthensis* which I made for Mr. Baldwin when he asked my advice about the specimen, and which he reproduced in his paper. Finally, as regards the hand of *E. sparthensis*, its apparent narrowness is simply due to the fact that it is axially rotated to a greater degree so that the movable digit is concealed by the immovable. Hands of scorpions are always narrower in this position than when resting so as to display the movable digit from the dorsal side.

The type of *E. sparthensis*, measuring about 74 mm. in total length, is imbedded in an ironstone nodule from the Middle Coal Measures of Sparth Bottom, near Rochdale in Lancashire. It is in the Manchester Museum. The Bohemian example in the British Museum measures about 75 mm. According to my observations upon this specimen, Fritsch's drawings of it on pl. xii of his monograph are inaccurate, notably, for example, in the curvature of the immovable digits of the chelæ.

Anthracoscorpio dunlopi, sp. nov. Plate I, fig. 1; Text-figure 5.

Of large size, approximately equalling the length of the largest known species of the order. Carapace approximately as long apparently as the humerus or brachium or movable digit of the chela, and not very much shorter than the sum of the first and second caudal segments. Its exact length, however, is uncertain, because the posterior border is not defined, and the portions I interpret as the frontal lobes may possibly be the basal segments of the cheliceræ. Since, however, these lobes are sculptured with longitudinal grooves, and the basal segments of the cheliceræ in recent Scorpions are polished so as to slide beneath the carapace, I judge the pieces in question to belong to the carapace. If this be correct the anterior border is emarginate, with a median notch from which a well-defined furrow-like groove extends backwards to the ocular tubercle, becoming shallower posteriorly. The tubercle is elongate, pointed behind and situated nearly in the middle of the carapace. The two eyes are indistinctly defined. No trace of lateral eyes has been preserved. Behind the tubercle a groove extends backwards towards the posterior border. On the left side of the posterior half of the

carapace a longitudinal groove runs obliquely backwards and inwards, its anterior extremity starting at a point nearly on a level with the posterior end of the ocular tubercle. The posterior portion of the carapace on each side of the median groove is distinctly but irregularly granular.

The abdominal terga are granular, but there is no evidence that they possessed either median or lateral crests. They appear to be perfectly normally constructed. The posterior borders of the first, second and third are not clearly

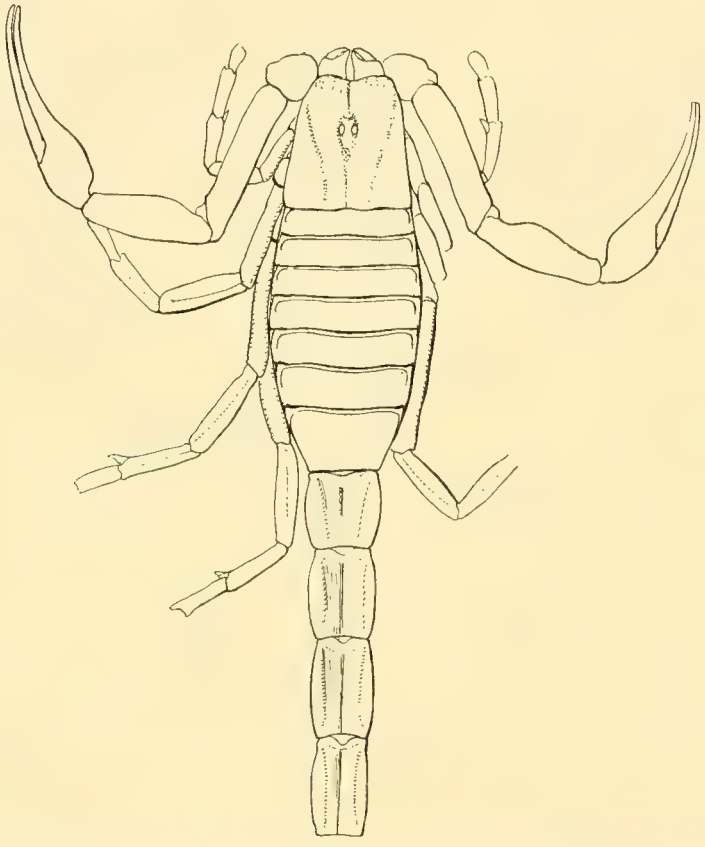


FIG. 5.—*Anthracoscorpio dunlopi*, sp. n.; suggested restoration of the type specimen, approximately nat. size, with the abdominal somites contracted.—Upper Coal Measures; Drumgray. R. Dunlop Collection.

defined; those of the fourth, fifth, sixth and seventh are more distinct, especially that of the sixth. The seventh tergal plate is a little longer than half the length of the carapace, its posterior width exceeding half its anterior width.

Of the tail only the anterior four segments and a portion of the fifth are preserved. It is nearly parallel-sided, the first segment being a little wider than the second, and the second than the third and fourth, the two last being approximately equal in width. The second, third, and fourth segments are almost equal in length, being a little longer and a little narrower than the first. The structure of the segments is normal, each being marked in the middle line by a shallow groove; the superior crests are small and distinctly and evenly granular, but in no

sense denticulated; the supero-lateral crests are similarly granular, and granules are irregularly scattered over the areas between the crests.

The cheliceræ are not well preserved, no details of the dentition being decipherable; but the movable digit appears to be strongly arcuate.

The chelæ are long and slender, somewhat recalling those of *Chelifer cancroides*. The humerus and brachium are subequal in length, and both, broadly speaking, about four times as long as wide. No trace of crests or granulation is preserved. The manus is slender and oval, its width being a little greater than that of the brachium, and little more than half the length of the back of the manus. The digits are slender, normally arcuate, the movable being about as long as the carapace, brachium, or humerus.

Portions of all the legs are preserved, showing the normal structure. Evidence for the existence of tibial spurs is to be found on the fourth and fifth legs, as in many genera of existing Buthidæ; but there also appears to be one on the first leg —a character not present in any recent species of the order. On the second leg of one side a pedal spur is also preserved. The femora, patellæ, tibiæ and protarsi are crested, and the femora at least are beaded with granules along their upper and lower edges. The claws are not preserved.

Approximate Measurements in mm. of Type Specimen.

Length of carapace	. . .	20?			
,, abdomen	. . .	40			
,, caudal segments 1 to 4	. .	50			
,, entire tail probably not less than		70			
,, entire animal ,, ,, ,,		130			
,, first caudal segment	. .	10·5	width of same	.	11
,, second ,, ,,	. .	13	,, ,,	.	10·5
,, third ,, ,,	. .	13	,, ,,	.	10
,, fourth ,, ,,	. .	13	,, ,,	.	10
,, humerus	. . .	21			
,, brachium	. . .	20	width of brachium	.	5
,, back of the hand	. .	9	,, of hand	.	6
,, movable digit	. .	20			

In the above-given table the probable total length of the tail has been guessed from the length of the fourth segment, 20 mm. being allowed for the fifth segment and the vesicle, which are not preserved. These two missing segments were probably not less, and may have been more than the amount supposed, since the fifth caudal segment is never shorter and is usually longer than the fourth in living Scorpions.

The type and only known specimen of this species is contained on the two pieces of a split shale from the Upper Coal Measures of Drumgray, near Airdrie, in Scotland. It is in the possession of Mr. R. Dunlop, to whom I have dedicated

the species in acknowledgment of his kindness in sending it to me for description.

The type of this species approaches twice the length of the type specimen of *A. sparthensis*. It also differs in its proportions, the tail being longer and the manus of the chela narrower. In *A. sparthensis*, for instance, the first four segments of the tail only exceed twice the length of the carapace by about one-third of its length, the carapace being approximately as long as the first and second segments together, whereas in *A. dunlopi* the first four caudal segments exceed twice the length of the carapace by at least half its length, and the carapace is distinctly shorter than the first two caudal segments so far as can be judged. In *A. sparthensis*, again, the width of the manus is nearly half the length of the movable digit, while in *A. dunlopi* it is rather less than one-third of the length. The smaller size of the example of *A. sparthensis*, coupled with the shorter tail, might be attributed to immaturity, were it not that the two known examples of this species are approximately equal in size and have all the appearances, judging from the firmness of the exoskeleton, of being adult. Moreover, the hands of the chelæ in young Scorpions are relatively narrower than in full-grown examples. Hence their greater relative width in *A. sparthensis* as compared with *A. dunlopi* is quite irreconcilable with the conclusion that the former specific name has been assigned to young examples of the latter species. For these reasons I have not hesitated to describe Mr. Dunlop's specimen as an example of a distinct species. This specimen was for some time in the possession of Dr. Peach, who made a drawing of it in close agreement with my own restoration. This drawing, accompanied by a short account, was published by Mr. Dunlop in the Annals of the Glenfield Rambler, No. 2, pp. 60—64, 1898, but no name appears to have been assigned to the specimen.

Anthracoscorpio buthiformis, sp. nov. Plate I, fig. 2; Plate II, fig. 1; Text-figures 6—8.

Dorsal integument finely and closely granular; neither the carapace nor the first six terga of the opisthosoma visibly keeled. Carapace about as long as its posterior width, its length a little exceeding that of the first and second caudal segments together, and about equal to that of the second and third, and to the fifth and half the fourth. The ocular tubercle in the middle of its anterior half; a shallow median longitudinal groove running from it posteriorly and expanding and deepening just before the posterior border; the anterior border of the carapace apparently slightly convex, perhaps with a small median excrescence; the posterior border slightly convex in the middle. Terga of the abdominal portion of the opisthosoma showing the anterior elevated rim, this region, thus distended, a little more than twice the length of the carapace. Tail, when complete, no

doubt a little more than three times the length of the carapace, for without the post-anal spine it is about twice and a half times the length; segments one to five gradually increasing in length; the first segment the widest, much wider than long, the second and third also wider than long, the fourth about as long as wide, the fifth longer than wide; the upper surface of the segments normally and strongly keeled, the superior keels converging on segments one to four, almost parallel on segment five; the upper surface hollowed between the superior keels, which, like the superior lateral keels, are granular. Chelæ slender, humerus and brachium each much shorter than the carapace, which is slightly shorter than

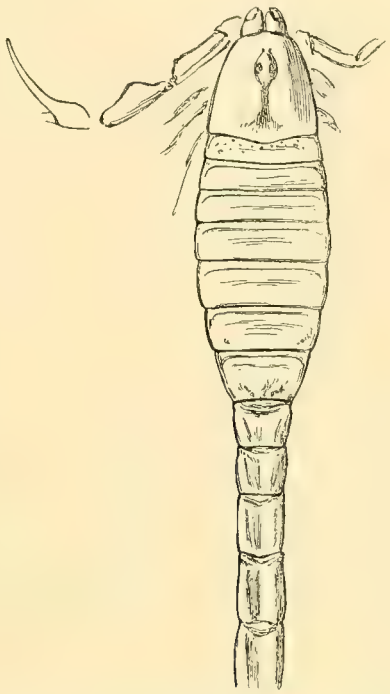


Fig. 6.—*Anthracoscorpio buthiformis*, sp. n.; four times nat. size.—Coal Measures; Sparth, near Rochdale. W. A. Parker Collection.

the manus with its digits. Manus slender, apparently keeled above and slightly wider than the brachium.

Measurements in mm.—Total length, exclusive of post-anal spine and cheliceræ, 21; length of carapace 3·5, of abdominal portion of opisthosoma 8; of caudal segments one to five about 10; length of first caudal segment 1·3, of second 1·6, of fourth 2, of fifth 2·5; width of first 2·5, of second 2 +, of fifth 2 −; length of manus and digits about 4.

Coal Measures of Sparth, near Rochdale.

Type above described in the Collection of Mr. W. A. Parker (Pl. II, fig. 1).

I have selected this specimen as the type because it shows the structure of the dorsal surface very clearly. Only fragments of the legs are preserved, but the details of the chelæ of the left side can be deciphered.

In addition to this specimen I have seen several examples from Dudley, which, in the absence of satisfactory proof of their distinctness from each other and from the type, I provisionally refer to this species. With the exception of one small specimen, which is immature if conspecific with the rest, I judge these specimens to be mature from the apparent thickness of the exoskeleton. The species therefore differs from *A. sparthensis* by its much smaller size. In the type specimen also the tail is shorter, the carapace being half the length of the first four caudal segments, whereas in *A. sparthensis*, as testified by the type, the carapace is less than half that length.

I subjoin the following notes on the examples from the Dudley Coalfield:

(1) Specimen in Mr. Madeley's Collection showing the chelæ, the trochanters, femora, and part of the patellæ of the leg of the first, second, and third pairs, the

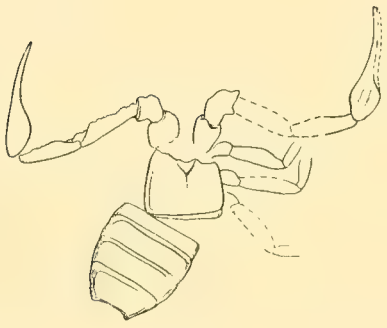


FIG. 7.—*Anthracoscorpio buthiformis*, sp. n.; about three times nat. size.—Coal Measures; Coseley, near Dudley. W. Madeley Collection.

FIG. 8.—*Anthracoscorpio buthiformis*, sp. n.; three times nat. size.—Coal Measures; Coseley, near Dudley. Wheelton Hind Collection.

greater part of the carapace, of which only the anterior portion is missing, and, following the carapace, a thin strip representing the first tergal plate of the opisthosoma. Behind the latter there lie, displaced to one side, the fourth, fifth, sixth, and seventh terga of the opisthosoma, which resemble in a general way the corresponding plates of Dr. Hind's specimen (No. 2). The carapace exhibits traces of the median ocular tubercle in front of its middle, but some distance from its anterior edge. The chelæ are slender, and recall those of some existing members of the Buthidæ, the "manus" being narrow, although wider than the brachium; the digits are long and slender, and apparently in contact throughout their length, the movable digit being a little more than twice the length of the back of the hand.

Approximate measurements in mm.—Width of carapace 3·5, of opisthosoma 4; length of humerus + brachium of chela 6, of manus + digits 5.

(2) Specimen in Dr. Wheelton Hind's Collection, showing the dorsal surface of the posterior part of the carapace, seven tergal plates and the first and second

caudal segments of the opisthosoma; also fragments of some of the anterior legs and apparently the maxillary processes of those of the first pair, where the anterior part of the carapace is missing. Of the fourth leg the trochanter, femur, patella, and part of the tibia are well exhibited. No trace of eyes is discernible. The sculpturing of the carapace, terga, and caudal segments is obscured, but the terga of the opisthosoma show clearly the anterior smooth elevated area which is normally overlapped in living Scorpions by the posterior border of the plate in front.

Approximate measurements in mm.—Length of abdominal terga of the opisthosoma 9·5, first tergum 1, third 1·5, fifth 2; width of opisthosoma 5; length of first and second caudal segments 4; femur of fourth leg 4, patella 3.

(3) Specimen in Mr. Egginton's Collection, showing, so far as the trunk is concerned, nearly the same features as Dr. Hind's example, the abdominal terga and two caudal segments of the opisthosoma being preserved. The anterior portion of the carapace is too much obliterated for description, but the ocular tubercle, in advance of the middle of this plate, is well shown with its two eyes. Fragments of appendages are shown on each side of the anterior half of the body, the femur of the left chela with an anterior granular crest, such as is present in most recent Scorpions, being preserved.

Approximate measurements in mm.—Total length from anterior end of carapace to posterior end of abdominal portion of opisthosoma 12, the carapace about 3 5, the rest 8·5; width of opisthosoma 5; distance of eyes from posterior edge of carapace 2; length of first caudal segment about 1, width nearly 2.

(4) Specimen in Mr. Egginton's Collection without tail and with the rest of the opisthosoma curved upwards as in the act of stinging. The chief interest of this specimen lies in the fact that the cheliceræ are preserved, showing obscurely the normal forcipate character of these appendages. Fragments of the appendages are obscurely indicated. Length of carapace about 3 mm.

(5) A very small, probably young specimen in Mr. Egginton's Collection, showing the dorsal view of carapace, of the anterior seven terga of the opisthosoma, and of the base of the tail. Total length (excluding base of tail) about 5 mm.; length of seven segments of opisthosoma 3·5 mm.; width 2 mm.

(6) Specimen in the British Museum, No. I. 1555 (Pl. I, fig. 2), from Coseley (Henry Johnson Collection). This example is of peculiar interest, since it shows portions of the sternal surface of the prosoma. The sternum is pentagonal, with its posterior border somewhat deeply excised; a little behind the excision lies a subtriangular genital operculum, and behind this there is a small sclerite representing the sternal plate of the pectines. Against the sides of the sternum on one side abut the coxæ of the legs of the third and fourth pairs as in existing Scorpions; and in front of it may be traced faint indications of the coxæ, with their maxillary processes, of the first and second pairs of legs; the maxillary

processes of those of the second pair appear to be exceptionally narrow. Seven terga of the opisthosoma are shown. These are very broad as compared with their length; but this may be due to flattening. At all events I do not propose to attach systematic weight to the character and separate this specimen specifically or generically from the others here described on the strength of this difference on the evidence of one specimen. Length of trunk (without tail) about 14 mm.; of seven segments of opisthosoma 9·5 mm.; width of opisthosoma about 6 mm.

The following fossils of doubtful generic position have also been referred to the Scorpiones.

(1) Segment of a tail from the Coal Measures of Carluke, Scotland (H. Woodward, Quart. Journ. Geol. Soc., vol. xxxii, pl. viii, fig. 5).

(2) Portion of a carapace referred by Peach to *Eoscorpius* sp. (Trans. Roy. Soc. Edinb., vol. xxx, pp. 404—405, pl. xxii, figs. 11 to 11*a*, 1883). The upper side of the carapace is swollen laterally, the swollen portions being separated by a median longitudinal groove, and each divided by lateral grooves into three portions. In front of the median groove lies the median ocular tubercle; lateral eyes are also described. According to Peach this carapace is intermediate between that of the species he described as *Eoscorpius tuberculatus* and *E. inflatus*.

(3) A carapace described by Peach as belonging to a species named *Eoscorpius inflatus* (Trans. Roy. Soc. Edinb., vol. xxx, pp. 405—406, pl. xxiii, figs. 12 to 12*d*, 1883). It is described as having the greater portion of its surface puffed up into three pairs of lobules separated by deep sulci, which emanate from a deep median longitudinal sulcus.

Peach himself suggests the possibility of this species belonging to the unclassified genus *Cyclus*. To a certain extent this author's descriptions of *E. inflatus* recall the characters of the carapace of some genera of Anthracomarti, such as *Eophrynus* and *Kreischeria*.

Order PEDIPALPI, Latreille.

Suborder UROPYGI.

Genus **GERALINURA**, Scudder.

1884. *Geralinura*, S. H. Scudder, Proc. Amer. Acad. Arts Sci., vol. xx, p. 19.
1890. *Geralinura*, S. H. Scudder, Mem. Bost. Soc. Nat. Hist., vol. iv, p. 454.
1904. *Prothelyphonus*, A. Fritsch, Palæoz. Arachn., p. 57.

Fritsch established the genus *Prothelyphonus* upon the species described by Kusta as *Thelyphonus bohemicus* and later as *Geralinura bohemica*. The alleged difference

between *Prothelyphonus* and *Geralinura* is the segmentation of the carapace in the latter and its entirety in the former; but since I cannot find any evidence from Scudder's figures of the type of *Geralinura*, namely *G. carbonaria*, that the carapace is segmented, I have placed *Prothelyphonus* as a synonym of *Geralinura*, reserving this name for the Carboniferous species of the Thelyphonidæ, not because they exhibit characters distinguishing them with certainty from existing genera, but because it is impossible to be sure that they belong to one or to more than one existing genus, and because the probabilities are in favour of their distinctness from all modern types.

No species of this group has hitherto been recorded from Great Britain. Several specimens, however, are contained in the collections at my disposal, although the material is, in my opinion, neither sufficiently abundant nor well preserved to admit of specific differences being with certainty established between the specimens. Provisionally, therefore, I refer them to one species.

The real interest of the specimens lies in the evidence they afford of the former existence of these Pedipalpi in Great Britain, and of their close agreement in structural characters with recent representatives of the suborder. Some of the Carboniferous specimens, that is to say, the two figured in this Monograph, seem to differ from modern types in having the three last segments of the opisthosoma less sharply marked off from the ninth segment and both wider and longer. But it is impossible to affirm this character of all extinct forms.

Geralinura britannica, sp. nov. Plate I, fig. 3; Plate II, fig. 3; Text-figure 9.

A species of small size with the dorsal surface covered with coriaceous granulation. Chelæ rather short and small, the five distal segments together rather shorter than the carapace. The three terminal segments of the opisthosoma long, nearly half the length of the rest of this region. Segments of the caudal flagellum about as wide as long.

Measurements in mm.—Total length from anterior end of carapace to end of the last segment about 17; length of carapace about 5, width 3·5; total length of opisthosoma (excluding flagellum) 11·5; width 4·5; length of segments two to nine, 8, ten to twelve (caudal portion) 3·5; length of visible portion of chela from base of femur 4·5.

Coseley, near Dudley.

Type in Mr. Walter Egginton's Collection, No. 51 (Pl. I, fig. 3).

This collection contains a second and less well-preserved specimen (No. 49) showing no features justifying its specific distinction from the type; and in Mr. Madeley's Collection there is an example from Coseley exhibiting the underside structurally in agreement, so far as can be seen, with recent forms. Its total

length is about 15·5 mm., the opisthosoma being 9·5 mm. and the prosoma 6 mm., the width of both regions being about 3 mm. There is a distinct spiniform process at the anterior extremity of the carapace as in certain recent forms, *e. g. Labochirus*.

In Dr. Moysey's Collection there is a specimen from the Shipley Claypit with the dorsal side exposed (Pl. II, fig. 3). The anterior portion of the carapace is broken away, showing vaguely the coalesced coxæ of the chelæ and the distal portion of the right chela. Behind the posterior border of the carapace there is a triangular plate which I regard as the posterior sternal plate of the prosoma, the exposure of which suggests that the overlying dorsal area was membranous; on each side of it may be seen the coxæ of the legs of the last pair. Nine terga of the opisthosoma are clearly discernible, but the three terminal segments of this

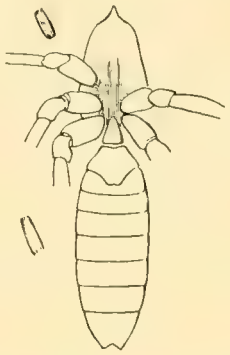


Fig. 9.—*Geralinura britannica*, sp. n.; restoration of ventral surface, three times nat. size.—Coal Measures; Coseley, near Dudley. W. Madeley Collection.

region are vaguely defined; they appear, however, to be comparatively large both in length and width; the post-anal flagellum is not preserved. Both the carapace and the terga and lateral membrane of the opisthosoma are granularly coriaceous.

Measurements in mm.—Total length about 20; length of opisthosoma 13, its length, excluding the last three segments, 10, its width 6; length of chela, excluding coxa, 7.

This specimen is a little larger than the type and has the chelæ decidedly longer. The difference in length, however, both of the body and the chela, may be attributable to age; and since the males of recent species very commonly have the chelæ much longer than they are in the females, it would be rash to attach specific importance to the difference observed, even if the type specimen were known to be fully adult.

Suborder AMBLYPYGI.

Genus **GRÆOPHONUS,** Scudder.

1890. *Græophonus*, S. H. Scudder, Mem. Bost. Soc. Nat. Hist., vol. iv, p. 453.

Although Scudder referred this genus to the same family of Pedipalpi as *Geralinura*, the two genera obviously belong respectively to the two suborders of the Pedipalpi known as Amblypygi and Uropygi.

Scudder only admitted one species of *Græophonus*, which he named *G. carbonarius*; but it appears to me to be very doubtful if the two specimens passing under that name can be referred even to the same genus. The type of *carbonarius* is an abdomen from Cape Breton and now in the Museum of the McGill College, Montreal. It was described as *Libellula carbonaria* under the belief that it belonged to a Neuropterous insect. It consists of twelve segments; but these are unlike the segments of any known Amblypygous Pedipalp, especially in the large size of the first and second plates. Moreover, the segments from the second to the seventh inclusive, are marked on each side *near the margin* by a circular impression. In the Amblypygi the tergal impressions are remote from the margin. On the other hand, the specimen from Mazon Creek, Illinois, upon which the genus *Græophonus* was quite clearly based, appears undoubtedly to be a Pedipalp of the suborder Amblypygi. Although Scudder identified this as *G. carbonarius*, it cannot, on the evidence, bear that specific name, as a comparison between the figures of this specimen (fig. 3, pl. xl, of the above-cited monograph) and the figures of *Libellula carbonaria* (pl. xl, figs. 2, 6) will make evident. In the Mazon Creek specimen the muscular tergal impressions are in agreement with those of a *Phrynus*; agreement may also be traced in many other particulars, such as the form of the carapace and the position of the ocular tubercle and the muscular grooves and pits. Scudder was, of course, mistaken in describing one of the chelæ as complete and nipper-like, its distal segments being obviously missing. It is in the structure of these appendages that *Græophonus* differs principally from recent genera of the group. Not only are they comparatively short and stout, especially with respect to the femoral segment, but, in addition, the axial rotation, which enables these limbs to fold up in a horizontal plane in recent forms, appears to be much less marked. They are, in fact, more porrect and fold in a nearly vertical plane, as was no doubt the case in primitive members of the Pedipalpi when the chelæ or palpi presented greater resemblance to the ambulatory limbs than is found in recent forms. This appears to me to be the chief character of morphological interest to be detected in *Græophonus*. One other distinctive feature may be mentioned. In all the specimens referred to this genus, where the carapace is well preserved, its anterior area, bearing the median ocular tubercle, is narrow and produced. This is shown

not only in the examples that I have seen, but also in Scudder's example from Mazon Creek, which I propose to call *Græophonus scudderi*.

Scudder describes this specimen as punctured. I do not doubt, however, that it was in reality finely granular.

It is somewhat singular that although only one undoubted specimen of *Græophonus* has been discovered in North America, and none have been recorded from Bohemia, the genus is represented in Britain by many specimens in the Carboniferous Beds of Staffordshire and South Wales.

Græophonus anglicus, sp. nov. Plate I, fig. 4.

Carapace approximately as long as wide, cordate, narrowed and produced anteriorly; the median ocular tubercle rounded, placed near the centre of the narrowed anterior portion, and defined behind by a crescentic groove; the area behind the tubercle rather flat; the median portion of the posterior part of the carapace a little elevated and marked with three impressions or muscular pits, one median in front and a pair, smaller and shallower, behind; from points on each side near these impressions radiate three grooves towards the margin. Opisthosoma elliptical, longer than wide, the terga marked with the normal muscular impressions. The distal end of the femur of the fourth leg, in its natural position, extending back beyond the extremity of the opisthosoma.

Tibia of palp or chela short, a little more than twice as long as wide, its length a little exceeding half the length or width of the carapace; its inner edge apparently armed with two spines; tarsus of chela apparently not less than half the length of the tibia, and also armed internally with two spines.

Approximate measurements in mm.—Total length 20; median length of carapace 7·5, lateral length 8·5; greatest width 8·5, width across front on a level with the ocular tubercle 2·5; length of opisthosoma 11?; length of segments four to nine 7·5; width of opisthosoma 8·5; length of tibia of chela 4, width 2.

Coseley, near Dudley.

The type, above described, is in the Collection of Mr. Walter Egginton (No. 1).

In addition to the type Mr. Egginton's Collection contains several examples of *Græophonus*, which I provisionally refer to this species. All are from Coseley.

The following points in them may be noted:

No. 40. Carapace approximately as in the type, the anterior oculiferous projection clearly shown. The terga of the opisthosoma are granular, and have a row of coarse granules along the posterior border. This region is narrower as compared with its length than in the type, the difference being perhaps sexual. Total length 14 mm., length of carapace 6, width 6·5; length of opisthosoma 8; femur of fourth leg about 8. Figured in Pl. I, fig. 4.

No. 2 shows more of the appendages than are seen in the type and No. 40, but

the anterior portion of the carapace is concealed; there is no evidence therefore that it projected forwards as in the other specimen. The greater portion of the chela is preserved, and the cheliceræ project forwards between their bases as a pair of slender rods. The coxæ of the posterior three pairs of legs are to be seen radiating from the narrow sternal area, and the legs of the second and third pairs are preserved nearly down to the ends of the tibiæ. The femur of the fourth leg is noticeably shorter than in No. 40. This difference may possibly be a question of age, the specimen now described being smaller than No. 40. In the chela the femoral segment appears to be spined internally. *Approximate measurements in mm.:* Total length 11; median length of carapace 3·5, width 4; length of opisthosoma 6·5, width 5; length of femur of second leg 4, of third 5, of fourth 5·5; coxa and trochanter of chela 2, femur 2, tibia 2·5.

No. 20: Larger than No. 2, but showing almost exactly the same features; the femur and tibia of the chela armed internally with a pair of spines. *Approximate measurements in mm.:* Total length 15·5; length of carapace 5, width about 6; length of opisthosoma 9, width 6·5; length of femur of second leg 7, of third 7·5, of fourth 9; length of femur of chela 3, its width 1·8; length of tibia of chela 4, its width 1·8.

In Mr. Henry Johnson's Collection from Coseley there is a specimen less well preserved than those described above and showing no points worthy of special comment. Its total length is about 13·5 mm., of which the carapace is 5 mm. and the opisthosoma 8·5 mm.; femur of third leg 6·5 mm.

In the Museum of the Geological Survey, Jermyn Street, there are a well-preserved opisthosoma, measuring 15 mm. long and 8 mm. wide, and a carapace measuring 4·5 mm. long and 6 mm. wide, which perhaps belong to the same species. They were found at the tip of an abandoned shaft (Glasbrook's) close to Cadoxton village, one and one-eighth miles north-east of Neath Station in S. Wales. There is no reason to suppose that these fragments belong to the same specimen. It may be noted that this carapace bears considerable resemblance to that of *G. scudderi*, but has the produced anterior region larger.

Order ARANEÆ, Sundevall.

Suborder MESOTHELÆ.

Genus **EOCTENIZA**, nov.

Generic Characters.—Carapace with its anterior portion somewhat sharply constricted to form a narrow, rounded, elevated, and convex cephalic area, defined from the large and broadly cordate posterior portion by a pair of shallow grooves,

which nearly meet in the middle line. This cephalic area bears the eyes, arranged in a transversely elongated, suboblong cluster, near its anterior border. The posterior area of the carapace is marked with three pairs of radiating grooves, those of the first pair being short and of the other pairs long; behind the posterior pair of these there is an angular median depression, the central fovea, from which passes a posterior pair of grooves. Opisthosoma oval, showing six distinct tergal plates.

Type Species.—*Eocteniza silvicola*, sp. nov.

In the Carboniferous genera and species of Araneæ with segmented opisthosoma, namely *Arthrolycosa antiqua*, Harger, *Scudderia carbonaria*, Kusta, ? genus *fortis*, Fritsch, ? genus *beecheri*, Fritsch, *Eolycosa lorenzi*, Kusta, *Protolycosa anthracophila*, Roemer, *Geralycosa fritschi*, Kusta, and *Rakovnicia antiqua*, Kusta, there appears to be no differentiated cephalic area such as is seen in *Eocteniza*. In *Palaranea borassifolia*, Fritsch, which its describer, in his last paper, re-named *Arthrolycosa ? palaranea*, there is no evidence that the opisthosoma is segmented, and therefore no reason for assigning the fossil to the genus *Arthrolycosa*. The type of *Eolycosa lorenzi* shows only a side view of the animal; but in this genus it appears that the whole carapace is strongly elevated. It may be added that the species *antiqua*, *carbonaria*, *fortis*, *beecheri*, *lorenzi*, and *borassifolia*, which Fritsch refers to the one genus *Arthrolycosa*, represent at least six genera and possibly as many families if the drawings are to be trusted.

Eocteniza silvicola, sp. nov. Plate II, fig. 4.

Carapace 5 mm. long, 4 mm. wide; abdomen about 5 mm. long, 3·5 mm. wide.
Coseley, near Dudley.
Type and only known specimen in the Collection of Mr. Walter Egginton.

Genus **ARTHROLYCOSA**, Harger.

1874. *Arthrolycosa*, O. Harger, Amer. Journ. Sci. [3], vol. vii, p. 219.
1889. *Arthrolycosa*, C. E. Beecher, Amer. Journ. Sci. [3], vol. xxxviii, p. 219.

I refer with doubt to this genus a fossil (Text-fig. 10) in Dr. Wheelton Hind's Collection, which is of very great morphological interest, although its exact systematic position is indeterminable. That it belongs to the order Araneæ rather than to the Pedipalpi, I infer from the shape of the carapace and of the opisthosoma. The carapace, although imperfect, appears to be about as broad as long, with nearly straight anterior and posterior borders and evenly convex lateral borders. It is marked with radial impressions and a somewhat Λ-shaped median

impression just in front of the posterior border. Faint indications of the basal segments of the legs are traceable on one side, no trace of the coxæ or sternal area of the prosoma being observable. The opisthosoma is wide, with its lateral and posterior borders strongly rounded; it is markedly narrowed in front and is distinctly segmented on its dorsal area, the terga extending across the whole width of this region from side to side. Of the segmentation of the greater part of the ventral surface I can affirm nothing with certainty except as regards the posterior extremity, where two annuliform segments surround the last or anal segment. The latter, as I interpret the fossil, consists of a transversely subelliptical tergal plate and of a crescentic sternal plate.

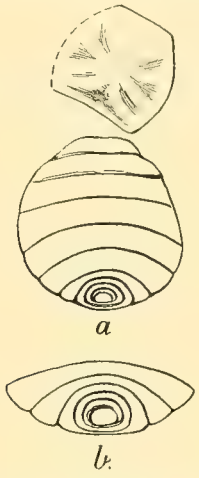


Fig. 10.—? *Arthrolycosa*, sp.—Coal Measures; Coseley, near Dudley. Wheelton Hind Collection. *a*, dorsal surface of carapace and of opisthosoma, the posterior segments of the latter showing through the overlying last tergal plate visible on the dorsal side, about four times nat. size; *b*, terminal segments of the opisthosoma, about six times nat. size.

Approximate length and width of carapace 4 mm.; length of opisthosoma 6 mm.; with 5·5 mm. or possibly less, if this region is expanded by crushing.

Coseley, near Dudley.

The morphological interest of this specimen lies principally in the structure of the posterior segments of the opisthosoma, which are unlike those of all recent Araneæ in being annuliform and firmly chitinised. In this character the fossil shows a nearer approach to the Pedipalpi, serving in a measure to bridge the interval between these two orders, which are admittedly related to one another. No trace of spinning appendages is to be seen. If they had been close to the anus, as in all recent Spiders except *Liphistius*, indication of this would probably have been preserved. Hence it may be supposed that they were situated somewhere near the middle of the ventral surface as in the last-named genus.

Suborder OPISTHOTHELÆ.

Genus **ARCHÆOMETA**, nov.

Generic Characters.—Resembling in general form such recent genera as *Nephila* and *Tetragnatha*, and possibly, like these, belonging to the family Argyopidæ. Carapace apparently cordate, narrowed in front. Legs very long and slender, probably 2, 4, 3, 1 in order of length judging by the length of the femora, though possibly those of the first pair exceeded those of the third by reason of the probably greater length of their terminal segments. The legs of the first and second pairs in most recent Araneæ (Spiders) are subequal in length, but in this Carboniferous genus those of the second pair greatly exceed those of the first. Femur of third longer than of first, femur of fourth a little longer than that of second. Abdomen long, apparently rather longer than femur of fourth leg, but its exact length a little doubtful owing

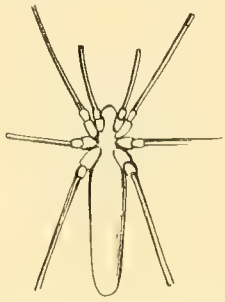


Fig. 11.—*Archæometa nephilina*, gen. et sp. n.; restoration of the ventral surface, showing the legs as far as the distal end of the femora and the probable form of the opisthosoma, about two and a half times nat. size.—Coal Measures; Coseley, near Dudley. W. Egginton Collection.

to the want of definition of its posterior end; subcylindrical in shape, a little narrowed posteriorly, ovally convex apparently anteriorly and rather more than three times as long as wide.

Type Species.—*Archæometa nephilina*, sp. nov.

The discovery of this Spider is of very great interest, because it puts beyond reasonable doubt the existence in the Carboniferous epoch of the Arachnomorphæ, which were previously not known to occur earlier than the Oligocene. It is, perhaps, necessary, however, to qualify this statement in connection with the genus and species described by Fritsch as *Pyritaranea tubifera*, which has the appearance of an Arachnomorphous form. But it is impossible to say much about this genus because the segmentation of the appendages, as represented by this author, is quite unlike that of any known Arachnid, living or extinct. Assuming that *Pyritaranea* was one of the Arachnomorphæ, as Fritsch suggests by his reference to the Clubionidæ in connection with it, *Archæometa* certainly differs from that genus in the greater length of its legs. In *Pyritaranea*, for example, an entire leg of the fourth pair only slightly exceeds the abdomen in length, and the

other legs are correspondingly short. The palpi, on the contrary, which are not shown in the specimen of *Archæometa*, are of most unusual length.

Archæometa nephilina, sp. nov. Text-figure 11.

Total length about 10 mm.; carapace about 3 mm. long, 2 mm. wide; abdomen about 7 mm. long, 2 mm. wide; femur, trochanter, and part of coxa of first leg 4 mm., of second leg 7·5 mm., of third leg about 5 mm., of fourth leg 8 mm.

Coseley, near Dudley.

Type and only known specimen in the Collection of Mr. Walter Egginton.

Order RICINULEI, Thorell.

Carapace or dorsal shield of the prosoma unsegmented, but with a movable plate, the cucullus, jointed to its anterior border and overhanging the jaws in front. Prosoma and opisthosoma united by a jointed waist, often marked by a lateral constriction. The opisthosoma either not visibly segmented or composed in the main of three very large segments, the last carrying a small jointed tail-like process, which is not always exposed; sometimes a shorter segment is visible in front of the first of the three large segments.

It is needless to give a complete diagnosis of this order, derived from the existing genera *Cryptostemma* and *Cryptocellus*. For this, reference may be made to Hansen's and Sörensen's monograph of 1904. The characters briefly enumerated above are taken from the known Carboniferous genera, and are sufficient to distinguish the Ricinulei from the other orders discussed in this Monograph.

Family Cryptostemmidæ, Westwood.

1874. *Cryptostemmidæ*, J. O. Westwood, Thes. Ent. Oxon., p. 210.
1884. *Poliocheridæ*, S. H. Scudder, Proc. Amer. Acad. Arts Sci., vol. xx, p. 16.
1890. *Poliocheridæ*, S. H. Scudder, Mem. Bost. Soc. Nat. Hist., vol. iv, p. 444.
1892. *Cryptostemmidæ*, T. Thorell, Bih. Svensk. Vet.-Akad., vol. xvii, 4, No. 9, p. 9.
1904. *Cryptostemmatoidæ*, H. J. Hansen and W. Sörensen, On Two Orders of Arachnida, p. 144.

I provisionally refer the Carboniferous genera of this order to the family Cryptostemmidæ, which has the characters of the order.

The two genera here admitted may be distinguished as follows:

a. Opisthosoma elongate, narrowed posteriorly, not consisting mainly of three large segments; cucullus transversely suboblong, markedly wider than long. *Curculioides*.

a'. Opisthosoma shorter, widely rounded posteriorly, composed mainly of three large segments; cucullus large, nearly as long as its basal width. . . *Poliochera*.

Genus **CURCULIOIDES**, Buckland.

1837. *Curculioides*, W. Buckland, Bridgewater Treatise (ed. 2), vol. ii, p. 76 (in part, *C. ansticii*).
1902. *Curculioides*, R. I. Pocock, Geol. Mag. [4], vol. ix, p. 439.
1890. *Geratarbus*, S. H. Scudder, Mem. Bost. Soc. Nat. Hist., vol. iv, p. 447 (in part, *G. scabrum*).
1890. ? *Kustarachne*, S. H. Scudder, Mem. Bost. Soc. Nat. Hist., vol. iv, p. 450.
1903. *Kustarachne*, A. L. Melander, Journ. Geol. (Chicago), vol. xi, p. 181.

The genus *Curculioides* was based by Buckland on two fossils in ironstone nodules from Coalbrook Dale, which this author regarded and described as Coleopterous insects. One of these was named *C. ansticii*, the other *C. prestvicii*. The latter was subsequently made the type of *Eophrynus* by Dr. Henry Woodward, who thus fixed *C. ansticii* as the type of *Curculioides*. In 1884 Scudder suggested that *C. ansticii* was an Arachnid related to *Architarbus*. I, on the contrary, suggested that it was allied to *Cryptostemma*, judging solely from the figure of it published by Buckland. The correctness of this surmise and the reasons given in support of it have been confirmed by specimens in Mr. Egginton's and Mr. Madeley's Collections.

That the Arachnid described by Scudder as *Geratarbus scabrum* is closely related to those that I refer to *Curculioides* is, I think, indisputable; but it is equally indisputable, in my opinion, that *G. scabrum* belongs to a different order of Arachnida from *G. lucoei*, which I have fixed as the type species of *Geratarbus* (Geol. Mag. [5], vol. vii, p. 511, 1910). About *Kustarachne* there is more room for doubt on account of Scudder's statement that the opisthosoma consists of nine segments, including the short two-jointed "protuberant pygidium." Although none of the specimens I have seen shows distinct signs of abdominal segments, the one in Mr. Madeley's Collection possesses what might be called a "protuberant pygidium," and this process is also well exhibited in Buckland's original figure. Nevertheless, it would have been difficult to justify the suggestion that *Kustarachne*, based upon *K. tenuipes*, belongs here, were it not that the species described by Melander as *K. sulcata* seems to be unmistakably akin to the examples in Mr. Egginton's Collection, which show the ventral side. Melander described *K. sulcata* as deeply punctured and as being provided with a triangular sessile pygidium of two, possibly three, segments. Apart from this last character the abdomen seems to show no segments. It is possible, of course, that *Kustarachne tenuipes* and *K. sulcata* differ generically. Nevertheless, the measurements of the two type specimens agree suspiciously closely, and both came from Mazon Creek, Illinois. I suspect that one shows the dorsal, and the other the ventral view of specimens belonging to the same species.

Curculioides ansticii, Buckland. Plate II, fig. 7; Text-figures 12, 13.

1837. *Curculioides ansticii,* W. Buckland, Bridgewater Treatise (ed. 2), vol. ii, p. 76, pl. 46″, fig. 1.

The exposed surface of both dorsal and ventral sides is closely covered with small punctures marking the hollows of granules. A specimen in Mr. Egginton's Collection (Pl. II, fig. 7), showing the dorsal surface from the ventral side and the ventral surface from the dorsal side on the two halves of a split nodule, has the carapace flattish and only a little vaulted, and apparently about as wide as long, though its lateral margins are not clearly defined. The posterior end of the abdomen is markedly narrowed. Portions of the legs are well shown, especially on the right side. The first and third are preserved as far as the end of the patella,

Fig. 12.—*Curculioides ansticii,* Buckland; suggested restoration of ventral surface of specimen No. 17, four times nat. size.—Coal Measures; Coseley, near Dudley. W. Egginton Collection.

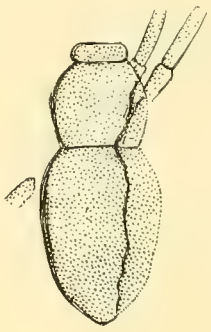


Fig. 13.—*Curculioides ansticii,* Buckland; dorsal surface, three times nat. size.—Coal Measures; Coseley, near Dudley. W. Madeley Collection.

of the second and fourth as far as the end of the femur. The first leg is the thinnest and the second the longest of the series, the femur of the second being about as long as the femur + patella of the third. *Approximate measurements in mm.:* Total length about 11, length (without cucullus) and width of carapace 4, length of abdomen 6·5, length of trochanter and femur of first leg 4, of second 6, of third 5, of fourth 6·5, of the femora alone in the order named 3, 5, 3, 3·5.

Another specimen (No. 17) in Mr. Egginton's Collection shows no structural features not exhibited in the first and is much less perfectly preserved. The abdomen appears to be more evenly oval and less narrowed posteriorly. The entire animal, in fact, seems to resemble *C. scaber* of Scudder in shape. *Approximate measurements in mm.:* Total length 12, length of carapace 4, width of carapace 4, length of abdomen 8, width of abdomen 5.

In Mr. Madeley's Collection there is a fairly well-preserved example showing the cucullus apparently entire. It has convex lateral margins and rounded angles;

its anterior and posterior borders are straight and parallel, and the plate does not expand towards its anterior border, as in existing genera, so that it may be described as transversely oblong. The carapace is a little wider than long, with the lateral borders convex, the widest point lying a little in front of the middle; its surface is moderately vaulted, its anterior portion being distinctly but evenly curved downwards towards the edge to which the cucullus is hinged. A distinct but shallow constriction marks the junction of the carapace and abdomen. The latter is elongate and oval, rather wider than the carapace; behind the widest point in front, the sides are slightly convex and converge gradually towards the posterior extremity, which shows indication of a median lobate excrescence. Portions only of some of the legs are preserved. *Approximate measurements in mm.:* Total length 12·5; length of carapace 4·5, width about 5; length of cucullus 1, width 2·5; length of abdomen 8, width about 5.

Thus these three specimens from Coseley, near Dudley, agree tolerably closely in dimensions. The type of *C. scaber*, Scudder, on the contrary, was larger, the total length being 15 mm., the length and width of the carapace 5·25 mm., the length of the abdomen 9·75 mm., and the width 6·25 mm. These measurements may be instructively compared with those of *Kustarachne sulcata*, Melander, from the same locality, namely Mazon Creek, Illinois, the total length being 15 mm. and the abdomen, without the "pygidium," 9 mm., with a width of 7 mm. Thus there is the same close agreement between the American specimens as between the English examples.

Genus **POLIOCHERA**, Scudder.

1838. *? Cryptostemma*, Guérin-Méneville, Rev. Zool., p. 10.
1884. *Poliochera*, S. H. Scudder, Proc. Amer. Acad. Arts Sci., vol. xx, p. 16.
1890. *Poliochera*, S. H. Scudder, Mem. Bost. Soc. Nat. Hist., vol. iv, p. 444.

Characters as above (p. 37).

Poliochera alticeps, sp. nov. Plate II, fig. 6; Text-figure 14.

Carapace elevated, convex from before backwards; the elevated area marked with a median groove ending behind in an impression, and an impression, probably muscular, far out on each side of this, a posterior curved groove passing on each side into a deeper impression defining the elevated area behind; the median length of the carapace about equal to its posterior width and as long as the anterior two large terga of the opisthosoma.

Opisthosoma wider than the carapace, its width less than its length; the three large segments subequal in length; each marked apparently with two

pairs of impressions, the anterior pair of the first small and widely separated, the posterior pair larger and closer together; those of the other terga equidistant from the middle line and in approximately the same straight line as the posterior pair of the first large tergal plate.

Measurements in mm.—Total length, exclusive of cucullus and caudal elongation, 5·5; length of carapace, excluding cucullus 2, width about 2·5; length of opisthosoma 3·5, width 2·8; length of first leg about 4·5, of third leg about 4.

Coseley, near Dudley.

Type and only known specimen in the Collection of Mr. Walter Egginton (No. 6).

This specimen, in a split nodule of clay ironstone, shows very clearly the dorsal surface with apparently the entire cucullus, portions of four pairs of ambulatory appendages and a short two-jointed caudal process.

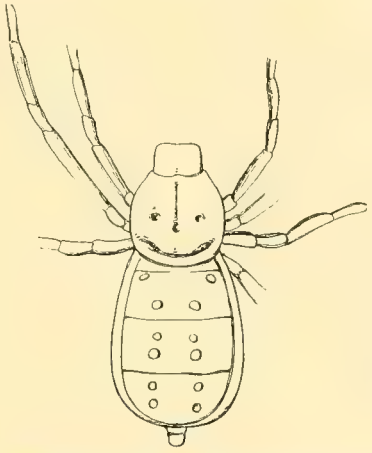


Fig. 14.—*Poliochera alticeps*, sp. n.; dorsal surface, showing the muscular impressions on the carapace and on the terga of the opisthosoma, six times nat. size.—Coal Measures; Coseley, near Dudley. W. Egginton Collection.

Although the type species of the genus *Poliochera*, namely *P. punctulata*, Scudder, shows no cucullus and is described as having the carapace flat, I think it probable that *P. alticeps* belongs to the same genus. Apart from the convexity of the carapace *P. alticeps* may be distinguished by its much smaller size, *P. punctulata* measuring 15 mm. in total length, of which the carapace is 6.

Order HAPTOPODA, nov.

No constriction between the prosoma and the opisthosoma, these regions apparently movably jointed together; the posterior end of the prosoma as wide as the anterior end of the opisthosoma. Carapace of prosoma approximately as wide as long, without trace of transverse grooves indicating segmentation. Opisthosoma longer than wide, narrowed posteriorly, rounded at the extremity, exhibiting in

one case ten terga on the dorsal side, and always a small anal operculum beneath the last, but on the ventral side. Thus eleven segments are traceable in the opisthosoma. The number of sterna is doubtful; but there appear to be at least nine, excluding the area between the coxæ of the last pair of legs, the first sternal plate being large with a widely convex posterior edge and the last small and encircling the sides and lower edge of the anal operculum. Mandibles or cheliceræ not fully known, but their basal segment elongate and porrect. Palpi short and pediform, consisting of six segments, the basal segment (maxilla) the largest, not concealed from below, and slightly divergent from its fellow of the opposite side. Legs of the first pair long, somewhat like those of the Thelyphonidæ, the terminal

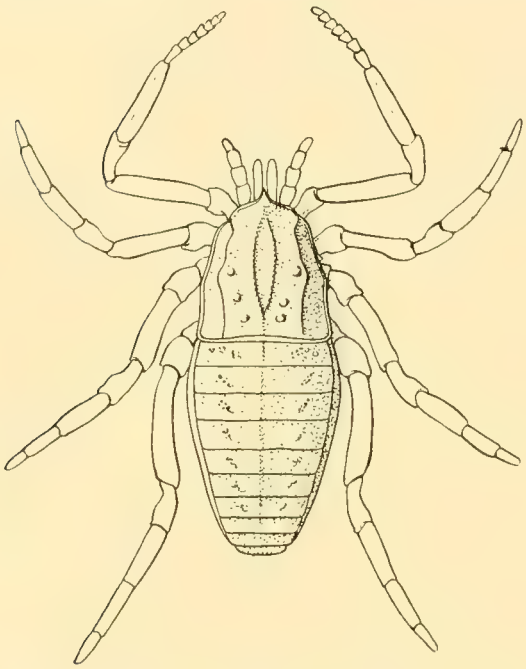


Fig. 15.—*Plesiosiro madeleyi*, gen. et sp. n.; dorsal surface with appendages restored from several specimens, four times nat. size.—Coal Measures; Coseley, near Dudley.

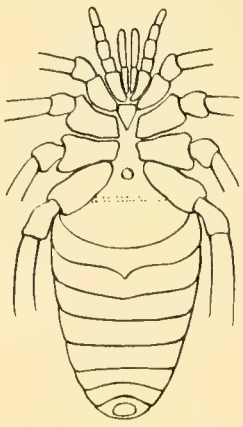


Fig. 16.—Suggested restoration of ventral surface of the same.

segments (protarsus and tarsus) converted into a seven-jointed tactile organ, apparently without a claw; the rest of the segments normal in number and structure. The remaining legs ambulatory, similar in form and in segmentation, each consisting of the normal seven segments characteristic of the Arachnida, the patella being short and the terminal segment (tarsus) undivided. Claws unknown. The basal segments large, those of the fourth leg the largest, separated in the middle line by an elongated sternal area which seems to expand behind between the coxæ of the fourth pair. Sternal plates of prosoma unknown, except for a small triangular anterior sternal plate lying immediately behind the basal segments of the palpi, and between those of the legs of the first pair and partially also between those of the second pair. Position of generative orifice unknown.

I have established this new Order, named in allusion to the tactile nature of the legs of the first pair, for a genus of Carboniferous Arachnida which cannot be fitted into any other Order of extinct or existing forms. In some respects it coincides with the definition of the Opiliones, notably in the total absence of constriction between the prosoma and opisthosoma, and in the number and nature of the tergal plates of the opisthosoma, and could hardly, indeed, be excluded from that Order by the structure of the appendages as seen from the dorsal side, although differing from all its known members in the *Thelyphonus*-like modification for tactile purposes of the legs of the first pair. The structure of the anal segment is also like that of some Opiliones, *e. g. Cyphophthalmus*, but it is also like that of the Anthracomarti. The arrangement, however, of the sternal plates of the opisthosoma and the position of the basal segments (coxæ) of the prosoma with regard to the sternal area of that region, so far as I can decipher them, are very different from what may be seen in the Opiliones. They may, indeed, be described as more in conformity with the normal and primitive than is exhibited in that Order, which in these particulars is the most specialised of all Arachnida, with the exception of the Acari.

Family Plesiosironidæ, nov.

Genus **PLESIOSIRO**, nov.

Generic Characters.—Carapace high, narrowed in front, its anterior border produced into a median beak-like spiniform process; marked on each side by a longitudinal crest extending from a point close to its antero-lateral angle to its posterior border; the area external to these crests sloped abruptly down to the lateral edge; the area between the crests flattish and marked with a pair of lightly-curved crests, which arise at the base of the spiniform process, diverge, then converge, and meet a little in front of the posterior border; posterior border straight. Opisthosoma narrowed posteriorly, the terga much wider than long, with straight posterior border, the last only being convex posteriorly. The sternal plate of the last, lying just in front of the transversely oval or subcircular anal operculum, strongly angled, the preceding two sterna progressively less strongly angled. Opisthosoma bordered laterally by an unsegmented ridge representing probably the pleural integument of this region.

Palpi with second segment (trochanter) short; third, fourth, and fifth segments longer and subequal in length; the sixth short and tapering. Legs longish, the femora and tibiæ the longest segments; tibia of first compressed; basal segment of terminal tactile portion of the limb much longer than the rest individually.

Type Species.—*Plesiosiro madeleyi*, sp. nov.

Plesiosiro madeleyi, sp. nov. Plate II, fig. 5; Text-figures 15, 16.

Integument finely granular. Carapace with its admedian crests finely beaded; the lateral crests apparently smoother; three tubercles forming an oblique line in the posterior half of the area on each side between the crests; the posterior width of the carapace a little less than its median length, the latter a little greater than the length of the anterior five terga of the opisthosoma. Opisthosoma longer than wide, its width about equal to the length of the anterior six terga; a narrow median granular crest on the anterior seven terga, and a few large granules forming an irregular, oblique, abbreviated crest on each side. The eighth tergal plate considerably shorter than the seventh; the ninth and tenth much shorter than the eighth.

First leg, excluding the coxa, about as long as the body; its femur about as long as the first four terga of the opisthosoma; and a little longer than the tibia; the tibia about twice as long as the patella; the basal segment (protarsus) of the terminal tactile portion longer than the other segments individually. Fourth leg with trochanter and femur about equal in length to the carapace. The four distal segments of the palpi about half the length of the carapace.

Measurements in mm. (of type).—Total length 11·5; length and width of carapace 5; length of opisthosoma nearly 7, its width 5, length of first leg about 11.

Coseley, near Dudley.

Type in the Collection of the late Mr. William Madeley. This specimen shows the basal segments of the mandibles, the two palpi, one complete leg of the first pair, the femur, patella, and half the tibia of the third leg, the femur and patella of the fourth, and the femur of the second; the shape of the carapace and the tergal plates of the opisthosoma. Also the posterior sterna of the opisthosoma; and the hollow spaces of the basal segments of the legs of the first pair.

Other specimens in Mr. Madeley's, Dr. Hind's, Mr. Priest's, and Mr. Egginton's Collections show additional features which have made it possible to restore the dorsal surface tolerably completely. Details of the ventral surface are in no instance well preserved, the sterna and the genital area of the opisthosoma being in every case obscurely indicated. A specimen in Mr. Egginton's Collection (No. 4) is noteworthy for being the only one to show ten distinct tergal plates on the dorsal side of the opisthosoma, the ninth and tenth in this specimen appearing as a single plate in the others, where the posterior end of the opisthosoma is preserved (Pl. II, fig. 5).

Order PHALANGIOTARBI, Haase.

1890. *Opiliones*, sub-order *Phalangiotarbi*, E. Haase, Zeitschr. deutsch. geol. Ges., vol. xlii, p. 650.
1910. *Phalangiotarbi*, R. I. Pocock, Geol. Mag. [5], vol. vii, pp. 508—512.

Carapace of prosoma unsegmented, bearing a single pair of median eyes near its anterior border. No constriction between the prosoma and opisthosoma, but the two regions apparently movably jointed together. Terga of the opisthosoma eight or nine in number and referable to two categories; the anterior five or six quite short and apparently movably jointed, the posterior three long and apparently fused, though the sutures between them persist. Sterna of the opisthosoma apparently only seven in number, the posterior three corresponding with the posterior three terga and the anterior four with the anterior six terga; the first sternal plate triangular and wedged between the coxæ of the last pair of appendages of the prosoma. The genital orifice either just in front of or just behind this plate. The anal orifice small, subapical, and perhaps closed by an operculum representing a tenth segment. Legs, where known, alike in structure and consisting of seven segments, of which the fourth or patella is subequal in length to the third (femur) or fifth (tibia). Palpi, where known, very short, slender, and pediform.

This Order is wholly extinct and is only known from the Coal Measures of Europe and North America.

Although this group has some structural points in common with the recent Opiliones, such as the single pair of eyes, the absence of constriction between the prosoma and the opisthosoma, the presence of probably ten segments in the opisthosoma and the simple, not chelate, palpi, I think it advisable, in the present state of our knowledge, to keep the two apart, the segmentation of the opisthosoma in the Phalangiotarbi being quite unlike that of the Opiliones.

Family Phalangiotarbidæ.

Phalangiotarbidæ, Haase and Pocock (references as above under Phalangiotarbi).

Sternal area of prosoma relatively large and longitudinally elliptical, considerably longer than wide. The coxæ of all the post-oral appendages radiating round it, with their distal margins overlapped by the edge of the carapace. Coxæ of the palpi narrow, and in contact in the middle line in front; coxæ of legs of first pair lying on each side of them and diverging obliquely forwards and outwards, not in contact with each other; those of the fourth pair diverging obliquely backwards and widely separated at their proximal ends and followed by a pair of coxa-like

sclerites separated by a narrow median suboblong area. Opisthosoma bearing eight tergal plates, of which the anterior five are short and nearly straight or slightly recurved, indicating that the posterior border of the carapace was also straight from side to side; these are followed by the three normal large plates.

With the exception of the three plates lying behind the sternum of the prosoma and the coxæ of the legs of the fourth pair, the significance of which is obscure, the morphology of this Arachnid, judging from the figure, seems to be clear. Judging from the size of the sternum of the prosoma and the wide separation of the coxæ of the legs of the first and fourth pairs, *Phalangiotarbus* is the least specialised member of the Phalangiotarbi.

Genus **PHALANGIOTARBUS,** Haase.

1872. *Architarbus*, H. Woodward, Geol. Mag., vol. ix, p. 385, pl. ix, fig. 1 *a—b* (*nec* Scudder).
1890. *Phalangiotarbus*, E. Haase, Zeitschr. deutsch. geol. Ges., vol. xlii, pp. 638 and 650, pl. xxx, fig. 3.
1910. *Phalangiotarbus*, R. I. Pocock, Geol. Mag. [5], vol. vii, pp. 510 and 512.

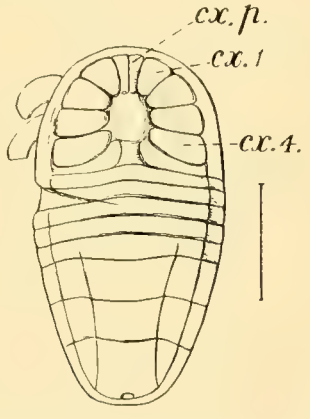


Fig. 17.—*Phalangiotarbus subovalis* (Woodward); ventral surface of the prosoma and dorsal surface of the opisthosoma exposed, three times nat. size.—Coal Measures; Lancashire. *cx. p.*, coxa of palp; *cx. 1*, coxa of first leg; *cx. 4*, coxa of fourth leg. After H. Woodward, Geol. Mag., vol. ix, pl. ix, fig. 1.

Characters as above.

Type Species.—*Architarbus subovalis*, H. Woodward.

Phalangiotarbus subovalis (H. Woodward). Text-figure 17.

1872. *Architarbus subovalis*, H. Woodward, Geol. Mag., vol. ix, p. 385, pl. ix, fig. 1 *a—b*.
1890. *Phalangiotarbus subovalis*, E. Haase, Zeitschr. deutsch. geol. Ges., vol. xlii, pp. 638 and 650, pl. xxx, fig. 3.
1904. *Architarbus subovalis*, A. Fritsch, Palæoz. Arachn., p. 35, fig. 39.
1910. *Phalangiotarbus subovalis*, R. I. Pocock, Geol. Mag. [5], vol. vii, p. 510.

The type and only known specimen of this species, which is known to me solely from the figure and description, is imbedded in an ironstone nodule from the Coal Measures of Lancashire.

Family Architarbidæ, Karsch.

Sternal area of prosoma small, and either subcircular or more usually narrow and elongate, the proximal ends of the coxæ being close together; the distal ends of the coxæ not, or hardly, overlapped by the edge of the carapace. Coxæ of palpi usually, at all events, entirely concealed from below by those of the legs of the first pair, which meet throughout their length in the middle line; only in *Geratarbus* do they appear to be in contact at their proximal ends, and diverge to a slight extent outwards, leaving a narrow space between. Coxæ of legs of fourth pair also meeting, or almost meeting proximally behind the posterior end of the sternal area. Opisthosoma with eight or nine tergal plates.

This family, in the sense in which I have recently defined it (Geol. Mag. [5], vol. vii, p. 512), contains several genera, of which only one, *Geraphrynus*, is known to be British, the others, namely, *Architarbus*, Scudder, *Geratarbus*, Scudder, and *Opiliotarbus*, Pocock, having been recorded from North America.

Genus **GERAPHRYNUS,** Scudder.

1884. *Geraphrynus*, S. H. Scudder, Proc. Amer. Acad. Arts Sci., vol. xx, p. 16.
1890. *Geraphrynus*, S. H. Scudder, Mem. Bost. Soc. Nat. Hist., vol. iv, p. 445.
1904. *Geraphrynus*, A. Fritsch, Palæoz. Arachn., p. 33 (in part).
1910. *Geraphrynus*, R. I. Pocock, Geol. Mag. [5], vol. vii, pp. 510, 512.

Generic Characters.—Body typically wide, its width across the anterior half of the opisthosoma nearly half the total length. Carapace usually angular in front, with its anterior lateral margins convex and gradually diverging to the posterior lateral angles, where the plate is widest; its posterior border either evenly convex or produced posteriorly in the middle. A pair of median eyes near the anterior extremity. Opisthosoma with nine tergal plates, the first two or more following the curvature of the posterior border of the carapace; the sixth segment much shorter than the seventh, and generally a little, sometimes markedly, longer than the fifth. A sulcus commonly traceable on each side of the terga, extending from a point not far from the postero-lateral angles of the carapace to the convex posterior border of the ninth plate, terminating one on each side of the anal orifice, and dividing the terga into three areas, a median and two lateral. The anal orifice subapical, and probably closed by a small opercular plate representing

the tergum of the tenth segment. Ventral surface of opisthosoma typically with seven sternal plates; the last three large and corresponding to the last three terga; the anterior four corresponding to the anterior six terga. The first and second sterna small and visible in the intercoxal space of the legs of the last pair, the first being triangular. Apparently a small orifice, the genital orifice, situated at the anterior extremity of the first and behind the sternal area of the prosoma.

Sternal area of prosoma narrow, much longer than wide, and consisting of five small plates, one pair between the coxæ of the legs of the third and fourth pairs, a second pair between those of the second legs and a small unpaired plate just behind the contiguous coxæ of the legs of the first pair.

Coxæ of the four pairs of legs large, triangular, and wedge-shaped, occupying the whole ventral area of the prosoma, with the exception of the narrow sternal region; each leg consisting of seven segments, including the coxa; the second

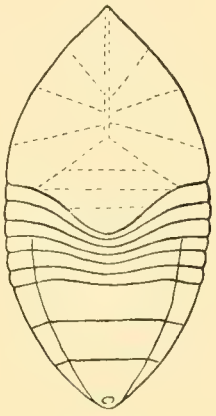


FIG. 18.—*Geraphrynus carbonarius*, Scudder; diagrammatic restoration of the dorsal surface of the type specimen, adapted from Scudder's figure (Proc. Boston Soc. Nat. Hist., vol. iv, pl. x, fig. 10), the dotted lines representing the coxal and sternal sclerites underlying the carapace, nearly three times nat. size. —Coal Measures; Mazon Creek, Illinois, U.S.A.

segment (trochanter) stout but short; the remaining segments thinner and longer, and not very unequal in length, with the exception of the seventh or tarsus, which is quite short, the fourth segment or patella being long, and not short as in the Opiliones. Palpi very short, probably six-jointed, their basal segments concealed from below by the united coxæ of the legs of the first pair.

Type Species.—Geraphrynus carbonarius, Scudder.

This generic diagnosis is based for the most part upon the British material of this genus that I have seen, checked by comparison with Scudder's figure of the type specimen of the typical species of the genus, *G. carbonarius*. Judging from this figure, *G. carbonarius* differs from all those described in this paper in the large size of the carapace as compared with the opisthosoma, the median length of the former exceeding the median length of the latter.

It is impossible to say with certainty how many species are represented by the

material from Dudley that I have seen. The following six, which may be determined by the subjoined key, appear at least to be distinguishable forms:

a. Carapace as wide as long or wider; length of the anterior four sternal plates of the opisthosoma much less than that of the posterior three.
  b. The posterior border of the carapace markedly sinuous, its lateral portions being slightly concave and its median portion convexly produced in the middle line.
    c. Opisthosoma longer and narrower in its posterior portion, the width of its penultimate segment about equal to the median length of the carapace; the posterior border of the seventh and eighth terga distinctly angled *angulatus*.
    c'. Opisthosoma shorter and wider in its posterior portion; the width of the penultimate segment considerably exceeding the median length of the carapace . . . . . *hindi*.
  b'. The posterior border of the carapace not markedly sinuous, either evenly convex or with its lateral portion nearly straight and no rounded median backwardly bulging area.
    d. Posterior border of carapace evenly convex from side to side; opisthosoma short, its greatest width nearly equal to its median length; no trace of tubercles on the anterior terga of the opisthosoma . . *eggintoni*.
    d'. Posterior border of carapace with its median area nearly straight, transverse, its lateral portions also nearly straight and inclined obliquely inwards and backwards from the angles; opisthosoma long, its greatest width only equal to the median length of the anterior eight segments; a pair of tubercles in the middle of the anterior six terga . . *tuberculatus*.
a'. Carapace distinctly longer than wide; width of the anterior four sternal plates of the opisthosoma nearly equal to the length of the posterior three.
  e. Width much more than one-third of the total length; anterior four terga of opisthosoma sinuous . . . . . *angustus*.
  e'. Width about one-third of the total length; only the anterior two terga of the opisthosoma sinuous . . . . . *torpedo*.

Geraphrynus angulatus, sp. nov. Plate III, fig. 2; Text-figures 19, 20.

Carapace closely granular, with median eyes distinct and placed apparently on a tubercle which has a convex anterior border; its posterior width a little exceeding its median length; its posterior border produced and convexly rounded in the middle, its sides slightly concave; the median area of the carapace about equal to that of the anterior eight tergal plates of the opisthosoma. The median area of the first two terga of the opisthosoma almost obliterated and overlapped by the median backward projection of the carapace; the posterior border of the third nearly straight; no large tubercles traceable upon the middle of the anterior six terga; the median length of the sixth a little exceeding half that of the seventh and a little less than half the median length of the eighth; the median length of the latter about half that of the ninth, the anterior width of the ninth rather less than two-thirds that of the sixth; the median length of the ninth about equal to its

anterior width. The posterior borders of the seventh and eighth distinctly angled in the middle line. On the seventh, eighth, and ninth terga a distinct integumental groove running from the anterior to the posterior border and representing apparently the external of the two pairs of grooves seen in other species, the internal grooves dividing the terga into three definite areas being invisible in *G. angulatus*.

First sternal plate of opisthosoma much longer than the second or third in the middle line; its posterior border emarginate; the second short, its median length about one-fourth its posterior width, narrower laterally, its anterior border fitting into the emargination of the posterior border of the first; the third only a little longer than the second in the middle line, its anterior borders lightly biangulate,

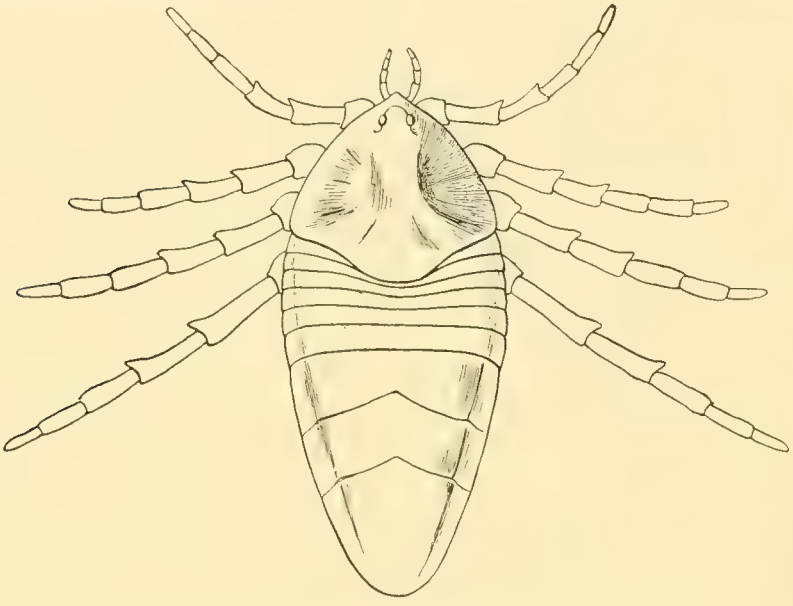


Fig. 19.—*Geraphrynus angulatus*, sp. n.; dorsal surface with appendages, four times nat. size.—Coal Measures; Coseley, near Dudley. Wheelton Hind Collection.

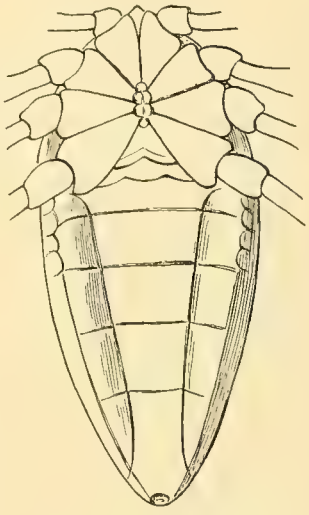


Fig. 20.—Ventral surface of the same.

its median length about half that of the fourth; the fourth, fifth, and sixth increasing gradually but slightly in length, but the sixth only a little longer than the fourth and barely two-thirds the length of the seventh.

Leg of first pair with trochanter, femur, patella and tibia about equalling the carapace in length; the same segments of the fourth leg equalling the last five terga or four sterna of the opisthosoma; the spiniform process on the distal inferior edge of the femora and patellæ apparently smaller than in other species (*e. g. G. hindi*) where they are shown.

Measurements in mm.—Total length 16; median length of carapace 6, width of latter 6·5; median length of opisthosoma about 10; width of the latter 7·5; length of sternal surface of opisthosoma 13; length of first leg from base of trochanter to end of tibia 5·5; the same segments of the fourth leg 9·5.

Coseley, near Dudley.

Type and only known specimen in the Collection of Dr. Wheelton Hind.

Geraphrynus hindi, sp. nov. Text-figures 21, 22.

Carapace of about the same shape as in *G. angulatus*. The anterior five terga of the opisthosoma more sinuous transversely, the lateral portion of the anterior borders slightly convex and the median areas slightly concave. In *G. angulatus* the third is scarcely sinuous, and the fourth is straight transversely. The posterior portion of the opisthosoma relatively much wider than in *G. angulatus*; the posterior border of the penultimate or eighth sternal plate about as long as the carapace and

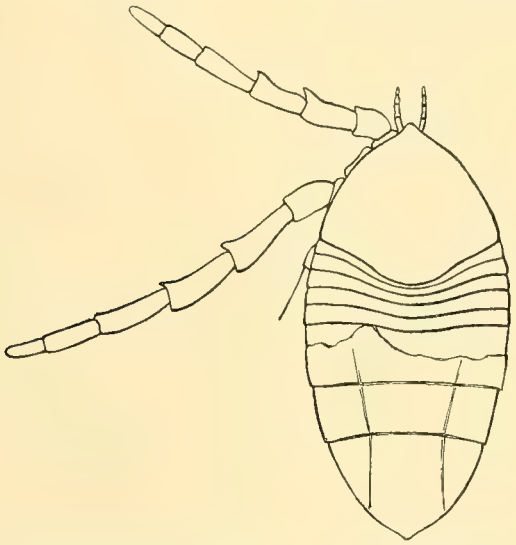


Fig. 21.—*Geraphrynus hindi*, sp. n.; dorsal surface with palpi and legs of first and third pairs, four times nat. size.—Coal Measures; Coseley, near Dudley. Wheelton Hind Collection.

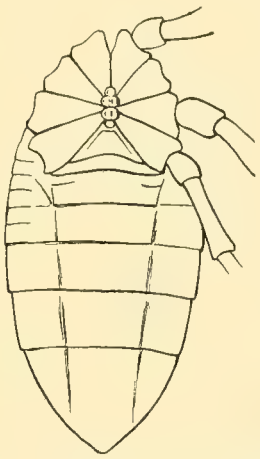


Fig. 22.—Ventral surface of the same.

a little greater than the median length of the eighth and ninth sternal plates; the posterior width of its median area much greater than its length. In *G. angulatus*, on the other hand, the posterior width of the plate is much less than the length of the carapace or than that of the eighth and ninth sterna, and the posterior width of its median portion is about equal to its length. Legs much longer than in *G. angulatus*, the trochanter, femur, patella and tibia, *i. e.* the second, third, fourth, and fifth segments of the third leg, exceeding the median length of the opisthosoma. In *G. angulatus* these same segments in the fourth leg are much shorter than the median length of the opisthosoma, and since the fourth leg in this genus is longer than the third, it is evident that the segments in question in the fourth leg of *G. hindi* would greatly exceed the median length of the opisthosoma.

Measurements in mm.—Total length 13; length of carapace 5, width 5·5; median length of opisthosoma 8, width of opisthosoma 7; length of ventral surface of opisthosoma from apex of first sternal plate 11; length of first leg, excluding coxa, 8, of third leg 11.

Coseley, near Dudley.

Type and only known specimen in the Collection of Dr. Wheelton Hind.

Geraphrynus tuberculatus, sp. nov. Text-figure 23.

Carapace thickly and closely granular, short, much wider than long, its median length about equal to that of the first seven tergal plates of the opisthosoma; its

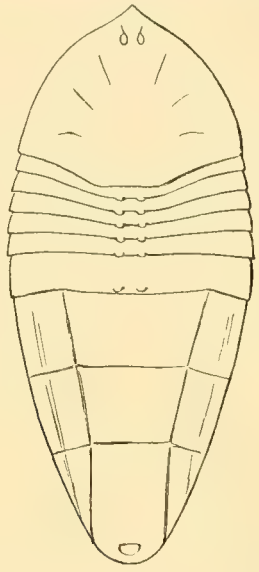


Fig. 23.—*Geraphrynus tuberculatus*, sp. n.; dorsal surface, four times nat. size.—Coal Measures; Coseley, near Dudley. W. Egginton Collection.

posterior border straight and transverse, in no sense convex, in the middle, almost straight and inclined obliquely forwards and outwards at the sides. The anterior six tergal plates of the opisthosoma each with a pair of distinct tubercles in the middle; the first and second curved round the posterior edge of the carapace; the third with its posterior border nearly straight; the median area of the first quite distinct; the sixth nearly twice as long as the fifth, and about half the length of the seventh or eighth; the latter about two-thirds the length of the ninth, the anterior width of which is about two-thirds the width of the sixth; the length of the ninth about three-quarters its anterior width. The posterior borders of the median area of the seventh and eighth terga straight, not angled.

Ventral surface and appendages unknown.

Measurements in mm.—Total length 18; length of carapace 6, width nearly 8; median length of opisthosoma 12, width of opisthosoma 8·5.

Coseley, near Dudley.

Type in the Collection of Mr. Walter Egginton (No. 46).

Mr. Egginton's Collection also contains a specimen measuring about 20 mm. long, which possibly belongs to this species, but is not sufficiently well preserved for description.

Geraphrynus eggintoni, sp. nov. Text-figures 24, 25.

Carapace about as wide as long; its median length about equal to that of the anterior eight tergal plates of the opisthosoma; its posterior border convex in the middle, but not produced, its lateral portion not concave or sinuous. Median area of first and second tergal plates of opisthosoma very narrow; posterior border of the third straight; the sixth nearly twice the length of the fifth, and about half

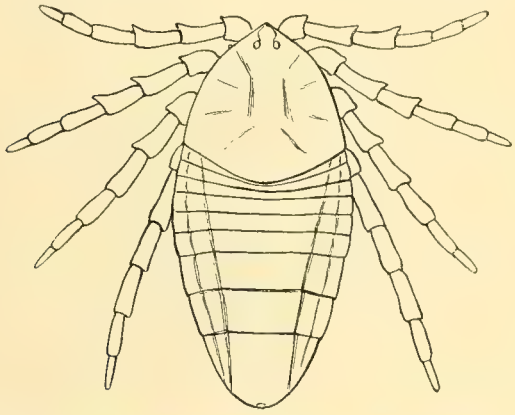


Fig. 24.—*Geraphrynus eggintoni*, sp. n.; dorsal surface with appendages, four times nat. size.—Coal Measures; Coseley, near Dudley. W. Egginton Collection.

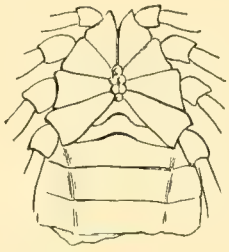


Fig. 25.—Ventral surface of prosoma and of anterior somites of opisthosoma of the same.

that of the seventh; the posterior border of the seventh and eighth straight; median area of seventh and eighth subequal and about two-thirds that of the ninth, the anterior width of which is about three-fourths the width of the seventh, and much greater than the median length of the ninth. On the ventral surface the first sternal plate seems to be much shorter in the middle line than in *G. angulatus* or *G. hindi*, owing to its deeper emargination; the second also is shorter than in the former species, more produced mesially in front and more emarginate behind, while the third is apparently much longer, being in fact as long in the middle line as the fourth. Legs short, that of the first pair with its trochanter, femur, patella and tibia about equal to the length of the carapace; the spines on the femur and patella well marked; trochanter, femur and patella of the third about equal to the carapace; the same segments and the tibia of the third about equal to the last five segments of the opisthosoma.

Measurements in mm.—Total length 12; length and width of carapace 5; median

length of opisthosoma 7, width of the latter about 6; length of first leg from base of trochanter 7, same of the third leg 8.

Coseley, near Dudley.

Type and only known specimen in the Collection of Mr. Walter Egginton.

This species has the legs short as in *G. angulatus*, but differs in the shape of the posterior border of the carapace, and of the seventh and eighth terga of the opisthosoma, this region also being shorter and broader than in that species. From *G. hindi* it differs in the shortness of its legs and the shape of the posterior border of the carapace, and from *G. tuberculatus* in its longer carapace, shorter opisthosoma, shape of the posterior border of the carapace, etc.

Geraphrynus torpedo, sp. nov. Plate III, fig. 1; Text-figures 26, 27,

Body long and narrow, nearly four times as long as wide. Carapace about

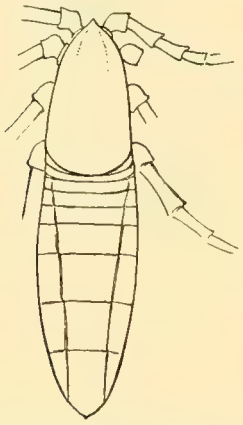


Fig. 26.—*Geraphrynus torpedo*, sp. n.; dorsal surface, about four times nat. size.—Coal Measures; Coseley, near Dudley. W. Egginton Collection.

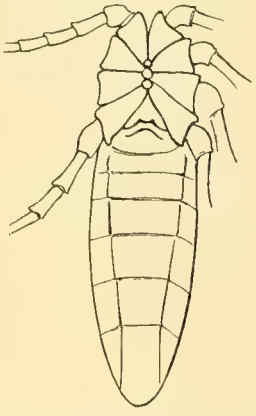


Fig. 27.—Ventral surface of the same.

one-third longer than wide, its median length about equal to that of the anterior eight terga of the opisthosoma, its width about equal to the length of the ninth and half the eighth terga, and therefore much less than half the length of the opisthosoma; its posterior border evenly convex. Opisthosoma nearly twice as long as wide, its width across the seventh tergum a little exceeding the length of the eighth and ninth terga; the first and second terga very narrow in the middle line, the median area of the first obliterated or overlapped by the posterior border of the carapace, the third, fourth and fifth straight and subequal in length, the fifth about half the length of the sixth, which is a little more than half the length of the seventh, the latter about equal to the eighth, and both of them shorter than the ninth. Fifth and sixth sterna of the opisthosoma subequal in length and shorter than the seventh; the sternal plate, corresponding to the third in the typical species of *Geraphrynus*, as long as the fourth and marked by a transverse ridge;

the second segment also long, with the median area of its anterior border considerably produced to fit into the correspondingly deep emargination of the first triangular intercoxal sternal plate. Coxal area of prosoma about one-fourth longer than wide. Leg of first pair apparently shorter than the carapace, which is about as long as the trochanter, femur, patella and tibia of the fourth leg.

Measurements in mm.—Total length 12; carapace almost 5, width of carapace 3; length of opisthosoma 7, width about 4; length of its last three segments about 5; of sternal area of opisthosoma nearly 10; width of coxal area of prosoma 3·5; length of fourth leg almost 7.

Coseley, near Dudley.

Type and only known specimen of this aberrant species in the Collection of Mr. Walter Egginton (No. 10).

Geraphrynus angustus, sp. nov.

Allied to the last but shorter; body about two and a half times as long as wide. Carapace about one-fourth longer than wide, median length equal to that of the anterior eight terga of the opisthosoma, its posterior border evenly and widely convex. Opisthosoma much less than twice as long as wide, its width about equal to the last three tergal plates; the first, second, third and fourth terga sinuously curved round the convex border of the carapace; the median area of the first obliterated, of the second very short; the anterior border of the fifth sinuous; the plate about half the length of the sixth, which is more than half that of the seventh; seventh and eighth subequal and each about three-quarters the length of the ninth.

Measurements in mm.—Total length 9·5; length of carapace 4, width 2·5; length of opisthosoma 5·5, width 3·8; length of sternal area of opisthosoma 7·5.

Coseley, near Dudley.

A single specimen in Mr. Walter Egginton's Collection (No. 36, one half labelled also 26).

In addition to its greater width as compared to its length, a character in which it serves in a measure to bridge over the interval between *G. torpedo* and the more normal species of *Geraphrynus*, this new species differs from *G. torpedo* in the sinuous curvature of the anterior four terga of the opisthosoma.

Order ANTHRACOMARTI, Karsch.

1882. *Anthracomarti,* F. Karsch (in part).
1885. *Meridogastra,* T. Thorell (as substitute for Anthracomarti).
1884 and 1890. *Anthracomarti,* S. H. Scudder (in part).
1890. *Anthracomarti,* E. Haase (*sensu stricto,* as Suborder of Opiliones).

1902–3. *Anthracomarti*, R. I. Pocock (*sensu stricto*).
1904. *Pleuraraneæ*, A. Fritsch (as Suborder of Araneæ).
1904. *Meridogastra* (= Anthracomarti), A. Fritsch (in part as Suborder of Opiliones).

Prosoma covered dorsally by a carapace consisting of a single plate, variable in form, but very generally marked posteriorly with a transverse groove indicating the line of fusion between the tergal plate of the sixth somite and those of the preceding five. No movable plate in front overhanging the cheliceræ. Eyes, when traceable, two in number.

Appendages of the first pair (cheliceræ) unknown. Those of the second pair (palpi) simple and pediform and consisting of six segments; those of the remaining four pairs similar in form, ambulatory in function, and consisting of seven segments. The basal segments or coxæ of the palpi and ambulatory limbs, *i. e.* of the five pairs of post-oral appendages, large, triangularly wedge-shaped, but movable and arranged round the narrower or wider sternal area, which was furnished with a median elongate sternal sclerite. Mouth-parts unknown.

Opisthosoma without appendages, movably jointed to the prosoma, but with its individual segments apparently welded together, though the sutural lines persist. Seven tergal plates are always traceable on the dorsal side, the first of the seven (*i. e.* the seventh counting forwards from the posterior end) being almost invariably longer than those that succeed it; each tergum is marked on each side with a longitudinal sulcus or groove which separates a lateral lamina from the median area of the tergum; sometimes there is a second sulcus nearer the external margin than the one just mentioned; hence each tergum is divided into either three or five distinct areas according to the number of sulci. In front of the seventh tergum from the end, either one or more tergal sclerites may be traced; these are usually not provided with lateral laminæ and may be overlapped more or less by the posterior border of the carapace; they appear to represent from one to three additional tergal plates undergoing excalation. The last tergal plate on the dorsal side, that is to say the seventh, not counting the variable number of anterior tergal plates just mentioned, is the narrowest of the series; but it is almost invariably provided with an unpaired posteriorly-expanding median lamina, in addition to its paired laminæ, with which it forms a continuous series; this lamina is itself sometimes marked off by a transverse sulcus from the median area of the tergum. This median lamina of the last tergum visible from the dorsal side, overlaps the tergal element of the next succeeding segment; the tergum of this segment is fused with its sternal element to constitute a subannuliform sclerite, near the centre of which lies a plate, the anal operculum, which is the tergal element of the last segment. Thus ten tergal elements may be traced with certainty in almost all genera, the last being the anal operculum and the first the short tergal area that lies between the carapace and the first large tergal plate of invariable occurrence, namely the seventh from the end on the dorsal side.

The sternal elements of the opisthosoma appear to correspond in number with the terga, except that, with the doubtful exception of *Eophrynus*, there is no sternal plate to represent the tenth tergum or anal operculum. Hence there are nine sternal plates in all, the last being the ventral element of the plate surrounding the anal operculum. The anterior sterna are variously modified and arranged according to the genus, the arrangement in *Anthracomartus* being very different from that of *Eophrynus*, the first, whether large as in the former or small as in the latter, being probably the genital operculum.

The morphology of the anterior region of the opisthosoma in this Order opens a wide field for speculation. I have already suggested two hypotheses to account for the facts, either or neither of which may represent the actual truth (see Geol. Mag. [4], vol. ix, pp. 443—448, 1902, and vol. x, pp. 250—251, 1903). But since seeing examples of *Anthracomartus* with its enlarged and posteriorly-projecting first sternal plate, which recalls so forcibly the genital operculum of the Pedipalpi, I am inclined to the opinion that my first-published view is probably correct, namely, that the genital orifice opened behind the first sternal plate in *Eophrynus* and *Anthracomartus*. This sternal plate, therefore, will be the sternum of the genital segment, the tergum of which is apparently the short first tergal plate, which is sometimes partially or wholly overlapped by the hinder border of the carapace. The tergal element of the pregenital segment seems to be present both in *Eophrynus* and *Kreischeria;* but I have not been able to recognise its sternal region in these genera, although in *Anthracomartus* there seems to be a comparatively large unchitinised area between the first sternal plate of the opisthosoma (the genital operculum) and the sternal plate of the prosoma.

The British genera referred to this Order appear to fall into the following four groups:

(1) *Brachypyge; Maiocercus.*

(2) *Anthracomartus.*

(3) *Anthracosiro; Trigonotarbus.*

(4) *Eophrynus; Kreischeria; Aphantomartus.*

In 1902 I proposed to refer the genera *Brachypyge* and *Anthracomartus* to the family Anthracomartidæ, and *Eophrynus* and *Kreischeria* to the Eophrynidæ. To these I added in 1903 the family Anthracosironidæ for *Anthracosiro*. At that time, however, I had not seen representatives of the genera *Anthracomartus*, *Kreischeria*, and the two described below as *Trigonotarbus* and *Aphantomartus*. The structure of the carapace shows that *Aphantomartus* belongs to the same category as *Eophrynus* and *Kreischeria*, and that *Trigonotarbus* is apparently related to *Anthracosiro*. On the other hand, the structure of the ventral surface of the opisthosoma in *Anthracomartus* is very different from that of *Eophrynus* and *Trigonotarbus*, the only other genera of the order in which this region has been

observed, yet the carapace of *Anthracomartus* is, generally speaking, like that of *Anthracosiro* and *Trigonotarbus*.

Of *Brachypyge*, as exemplified by the type species *B. carbonis*, only the dorsal surface of the opisthosoma is known. Of the second species, which has been referred to the genus, namely, *B. celtica*, only the ventral area of the opisthosoma has been described and figured. These two species resemble each other, and differ from the rest of the Anthracomarti in the production of the angles of the pleural plates into spiniform processes. The two species are probably, but certainly not closely, allied, and there are good grounds for regarding them as distinct genera. There seem to me to be no justifiable reasons for assuming that the anterior sterna of the opisthosoma of *B. celtica* have been wrongly depicted. If correctly drawn, they differ greatly from the corresponding plates of *Anthracomartus*. On the strength of this difference, supplemented by the peculiar formation of the margins of the pleural plates, above alluded to, I am now disposed to separate *Brachypyge* from the family Anthracomartidæ, and erect for its reception the family Brachypygidæ. For *Anthracosiro* and *Trigonotarbus* the name Anthracosironidæ may be retained; while the Eophrynidæ will comprise *Eophrynus*, *Kreischeria*, and *Aphantomartus*.

The four families may be distinguished as follows:

a. Margins of the pleural laminæ concave with spiniform angles; pleural laminæ large and divided as in the Anthracomartidæ, but the anterior sterna of the opisthosoma, where known, not enlarged and backwardly produced . . *Brachypygidæ*.

a'. Margins of the pleural laminæ of the opisthosoma convex, the angles not produced.

b. Carapace of prosoma not markedly sulcate except posteriorly; its lateral and anterior portions sloped gradually or steeply downwards to the margin.

c. Opisthosoma with very large pleural laminæ, each of which is divided into an external and an internal moiety by a sulcus visible on the dorsal and ventral sides; the anterior sternal plates swollen and produced backwards in the middle line and furnished on each side with a deep depression; the posterior sternal plates produced forwards and mesially angular *Anthracomartidæ*.

c'. Opisthosoma with its pleural laminæ small or moderate and undivided, not defined by a sulcus on the ventral side; anterior sterna small, not backwardly produced and not deeply impressed laterally; posterior sternal plates not angularly notched in the middle line . . *Anthracosironidæ*.

b'. Carapace of prosoma transversely sulcate; its lateral portions extended as a horizontal sulcate lamina considerably beyond the elevated median portion; opisthosoma with pleural laminæ undivided, its sterna as in the Anthracosironidæ . . . . . *Eophrynidæ*.

Family Brachypygidæ, nov.

Characters as above.

I refer the two known species of this family to the following genera, which may be distinguished thus:

a. Opisthosoma much longer than wide; pleural laminæ of the second and third pleura-bearing terga inclined slightly backwards . . . . . *Brachypyge*.

a'. Opisthosoma much wider than long; pleural laminæ of the first, second, third, and fourth sterna inclined slightly forwards . . . . . *Maiocercus*.

Genus **BRACHYPYGE**, H. Woodward.

1878. *Brachypyge*, H. Woodward, Geol. Mag. [2], vol. v, pp. 433—436, pl. xi.
1902. *Brachypyge*, R. I. Pocock, Geol. Mag. [4], vol. ix, pp. 488, 491.
1904. *Brachypyge*, A. Fritsch, Palæoz. Arachn., p. 41.

Type Species.—Brachypyge carbonis, H. Woodward.

Brachypyge carbonis H. Woodward. Text-figure 28.

1878. *Brachypyge carbonis*, H. Woodward, Geol. Mag. [2], vol. v, pp. 433—436, pl. xi; also Bull. Acad. Roy. Belg. (2), vol. xlv, no. 4, pp. 410—415, with plate.

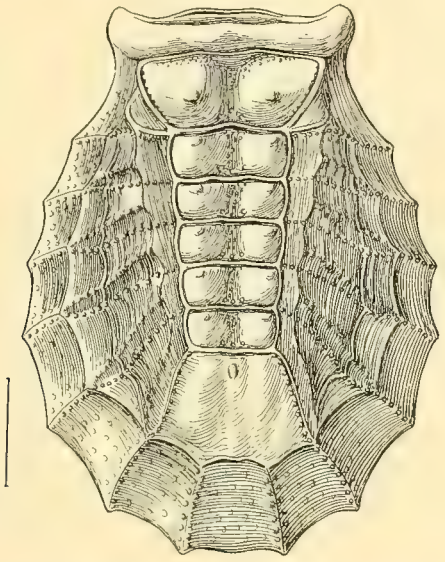


Fig. 28.—*Brachypyge carbonis*, H. Woodward; dorsal surface of opisthosoma, five times nat. size.—Coal Measures; Mons, Belgium. After H. Woodward, Geol. Mag. [2], vol. v, pl. xi.

1885. *Anthracomartus carbonis*, S. H. Scudder, C. R. Soc. Ent. Belg., vol. xxix, pp. 84—85.
1887 and 1896. *Eophrynus carbonis*, H. Woodward, Geol. Mag. [3], vol. iv, p. 49; also Quart. Journ. Geol. Soc., vol. lii, p. cix.
1902. *Brachypyge carbonis*, R. I. Pocock, Geol. Mag. [4], vol. ix, p. 488.
1904. *Brachypyge carbonis*, A. Fritsch, Palæoz. Arachn., p. 42.

Only the dorsal area of the opisthosoma is known. Judging from the figure this shows the following interesting structural characters: There are eight well-defined tergal plates. The first is short; but it is wider than the anterior border

of the second; it has no laminæ, but bears two widely separated tubercles. A pair of similar but larger tubercles is present on the elevated median area of the six following terga. The second tergal plate is large; its pleural laminæ are distinct, with their postero-lateral portion inclined outwards and slightly backwards. The pleural laminæ from the third to the seventh are widely extended laterally and divided by a distinct sulcus into an external and internal moiety. The median area of the terga is narrow as compared with the same area in *Anthracomartus*. The median area of the eighth tergal plate is very long and the inner moieties of the pleural laminæ are not differentiated. In this respect *B. carbonis* differs from all the other members of the Anthracomarti hitherto described; and it is the elongation of the tergal plate which gives the characteristic length to the opisthosoma.

Genus **MAIOCERCUS**, nov.

Characters as above (p. 59).

Type Species.—*Maiocercus celticus*, Pocock.

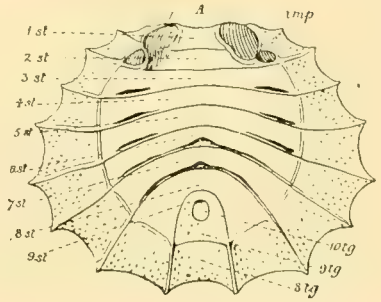


Fig. 29.—*Maiocercus celticus* (Pocock); ventral surface of opisthosoma, nat. size.—Coal Measures; Ty'nybedw, Rhondda Valley, S. Wales. *1 st.* to *9 st.*, sterna of the first to the ninth somites; *8 tg.*, ventral side of median lamina of the last tergal plate visible on the dorsal side; *9 tg.*, area regarded as the tergal plate of the ninth somite; *10 tg.*, anal operculum or tergal plate of the tenth somite; *imp.*, impression (? coxal) marking the first and second sternal plates. From Geol. Mag. [4], vol. ix, p. 491.

Maiocercus celticus (Pocock). Text-figure 29.

1896. *Eophrynus carbonis*, F. T. Howard and T. H. Thomas, Trans. Cardiff Nat. Hist. Soc., vol. xxviii, p. 52, figs. *a* and *b* (*nec* Woodward).

1902. *Brachypyge celtica*, R. I. Pocock, Geol. Mag. [4], vol. ix, p. 488, fig. 2 *a*.

1904. *Brachypyge celtica*, A. Fritsch, Palæoz. Arachn., p. 41.

The figure of the ventral surface of the opisthosoma of this species suggests that the genus *Maiocercus* is much more closely allied to *Anthracomartus* than is *Brachypyge*. The chief resemblance to *Brachypyge* lies in the scalloped edge of the pleural laminæ. There is no reason to suppose that the eighth somite is elongated as in the latter. The posterior borders of the sixth and seventh sterna show the

mesial angular notch present in *Anthracomartus*, but the first and second sternal plates are not enlarged and posteriorly produced as in *Anthracomartus*. There is, however, on each side of them a distinct impression which I suggested in 1902 indicated possibly the position of the coxæ of the legs of the last pair.

Family Anthracomartidæ, Haase.

(= *Anthracomartidæ* + *Promygalidæ*, Fritsch.)

Carapace of prosoma not differentiated into definite regions as in the Eophrynidæ, at most marked by a single posterior transverse sulcus. Cheliceræ not certainly known, but apparently very slender, with thin, rod-like basal segments. The remaining appendages normal, with their basal segments arranged subradially round a wide sternal area; sternal plate unknown. Opisthosoma with its lateral and posterior borders forming a continuous widely-rounded curve, exhibiting eight tergal plates on the dorsal side; the first very short, narrowed laterally, without pleural laminæ, and partially or wholly overlapped by the posterior border of the carapace; the rest with very large pleural laminæ, divided into an outer and an inner plate by sulci; these sulci form a continuous series passing round the opisthosoma in a line concentric with the lateral and posterior borders, starting at the antero-lateral angles of this region in front and cutting posteriorly the unpaired median pleural lamina of the last tergal plate on the dorsal side. The median area of the first large pleura-bearing tergal plate usually widened in front. In the posterior half of the opisthosoma the pleural laminæ are directed obliquely backwards, so that the posterior borders of the terga form a strongly curved line, concave backwards.

On the ventral surface nine sternal areas are distinctly traceable in front of the anal operculum. The posterior borders of the fifth to the eighth are strongly recurved and notched in the middle line, giving a marked and characteristic angular appearance to these plates. The first visible sternal plate, no doubt the genital operculum, is large and wide, with concave anterior border and a more or less angularly produced posterior border. It lies well behind the coxæ of the posterior limbs of the prosoma and is in no sense wedged in between them as in the Eophrynidæ. Usually, at all events, it has a median ridge or prominence. The second and third plates follow, roughly speaking, the curvature of the first, their posterior borders being convex backwards. The third plate is sharply marked off from the fourth by what appears to be a strong hinge. Passing obliquely backwards and inwards from the lateral portion of the third plate towards the anal operculum, there is, on each side, a strong ridge. The sternal areas between these ridges are depressed so that the middle of the ventral surface behind the third sternal plate is arched. Outside these ridges the ventral surface is sloped obliquely

upwards to the inner edges of the pleural plates, the pleural plates themselves lying more in a horizontal plane. When directed backwards the fourth leg lies apparently in the space beneath the pleural plates and against the upsloping external area of the ventral surface. In front of the first sternal plate, and between it and the sternum of the prosoma, with the coxæ of the legs of the last pair on each side, there is a longer or shorter area which was probably membranous. This, perhaps, represents the sternal region of the pre-genital segment, which seems to be unrepresented on the dorsal side of the opisthosoma. The sulcus on the dorsal side, which cuts the laminæ into two moieties, is represented on the sternal side by a similar sulcus following the curvature of the lateral and posterior borders of the opisthosoma.

I believe the above-given interpretation of the ventral surface of the opisthosoma to be, approximately at all events, correct. But in no specimen that I have seen is the ventral surface exposed fully from below. In every case where the sternal plates are well shown it is their inner surface that is exposed—that is to say, the organism is split in two in such a way that the dorsal area is seen from below and the ventral area from above. Hence in my description of the ventral skeletal plates I have interpreted grooves and hollows as ridges and elevations respectively, and *vice-versâ*. This opens up possibilities of error which must not be lost sight of; and when discussing *Promygale* and *Anthracomartus* in the November issue of the Geological Magazine for 1910, I inadvertently fell into the error of describing a deep groove on each side of the lower surface of the opisthosoma. The structure should have been described as a ridge.

The Anthracomartidæ are sharply distinguished from the Eophrynidæ and from the Anthracosironidæ, as exemplified respectively by *Eophrynus* and *Trigonotarbus*, not only by the structure of the anterior sternal plates of the opisthosoma, but also apparently by the separation of the pleural plates into an outer and an inner moiety by sulci, which are apparent upon the ventral as well as upon the dorsal surfaces. They further differ from the Eophrynidæ, but not from the Anthracosironidæ, by the structure of the carapace of the prosoma.

Genus **ANTHRACOMARTUS**, Karsch (emend.).

1882. *Anthracomartus*, F. Karsch, Zeitschr. deutsch. geol. Ges., vol. xxxiv, p. 556.
1885. *Anthracomartus*, S. H. Scudder, Proc. Amer. Acad. Arts Sci., vol. xx, p. 17.
1890. *Anthracomartus*, E. Haase, Zeitschr. deutsch. geol. Ges., vol. xlii, p. 645.
1901. *Promygale*, A. Fritsch, Fauna der Gaskohle, vol. iv, p. 58.
1902. *Anthracomartus*, R. I. Pocock, Geol. Mag. [4], vol. ix, p. 491.
1904. *Anthracomartus*, A. Fritsch, Palæoz. Arachn., p. 36.
1904. *Promygale*, A. Fritsch, Palæoz. Arachn., p. 19.
1910. *Anthracomartus*, R. I. Pocock, Geol. Mag. [5], vol. vii, pp. 504—508.

Generic Characters.—Carapace high; the median portion of its upper surface nearly flat or slightly excavated; the lateral and anterior portion sloped nearly vertically downwards to the lateral and anterior border; the posterior portion much more gradually sloped backwards to the groove which defines the posterior border; this border straight or slightly emarginate; the postero-lateral angles rectangular; the lateral borders subparallel for more than half their length, but converging anteriorly from a point approximately on a level with the articulation of the legs of the second pair, to form an angular prominence over the mandibles; the edges of the flattened dorsal area defined by a marked ridge which exhibits anteriorly a low and short crest or thickening, perhaps marking the position of the lateral eyes; the descending portion in the middle line in front compressed or defined by a pair of grooves which pass downwards to the marginal angle above the mandibles.

Opisthosoma and limbs constructed as described under the diagnosis of the family.

Type Species.—*Anthracomartus voelkelianus*, Karsch, from the Coal Measures of Silesia.

Generic value has been assigned to the characters presented by the carapace, because it appears to me probable that *A. palatinus*, Ammon, if the figure is to be trusted, will have to be separated from *Anthracomartus* on account of the difference in the shape of the carapace, which is much wider than long, somewhat constricted posteriorly, and has the antero-lateral angles widely rounded. Moreover, the antero-lateral angles of the opisthosoma project prominently beyond the postero-lateral angles of the carapace. Ammon detected a pair of median eyes near the front of the upper surface of the carapace in his species. No such eyes were seen in any of my specimens.

It is needless to repeat here the reasons I have already published for regarding *Promygale* as a synonym of *Anthracomartus* (see Geol. Mag. [5], vol. vii, pp. 505—508, 1910).

The chief distinctive features of the two species of this genus described below may be briefly epitomised as follows:

a. Total length of adult from about 21 to 25 mm.; seventh tergal plate of opisthosoma larger, the length of its median area approximately equal to its anterior width; the triangular lateral pleural plate correspondingly long . . . . *hindi*.

a'. Total length of adult from about 10 to 12 mm.; seventh tergal plate of opisthosoma smaller, the length of its median area much less than its anterior width; the triangular lateral pleural plate correspondingly short . . . . *priesti*.

Neither of these can be identified, at present, with any described form.

Anthracomartus hindi, sp. nov. Plate III, fig. 3; Text-figures 30—32.

Carapace about as long as wide or a little longer; its median length about equal to that of the anterior[1] five tergal plates of the opisthosoma; its surface, like the dorsal and ventral surfaces of the opisthosoma, finely, closely, and nearly uniformly granular throughout. The first tergal plate of the opisthosoma large; its median length nearly equal to that of the second and third taken together; the median lengths

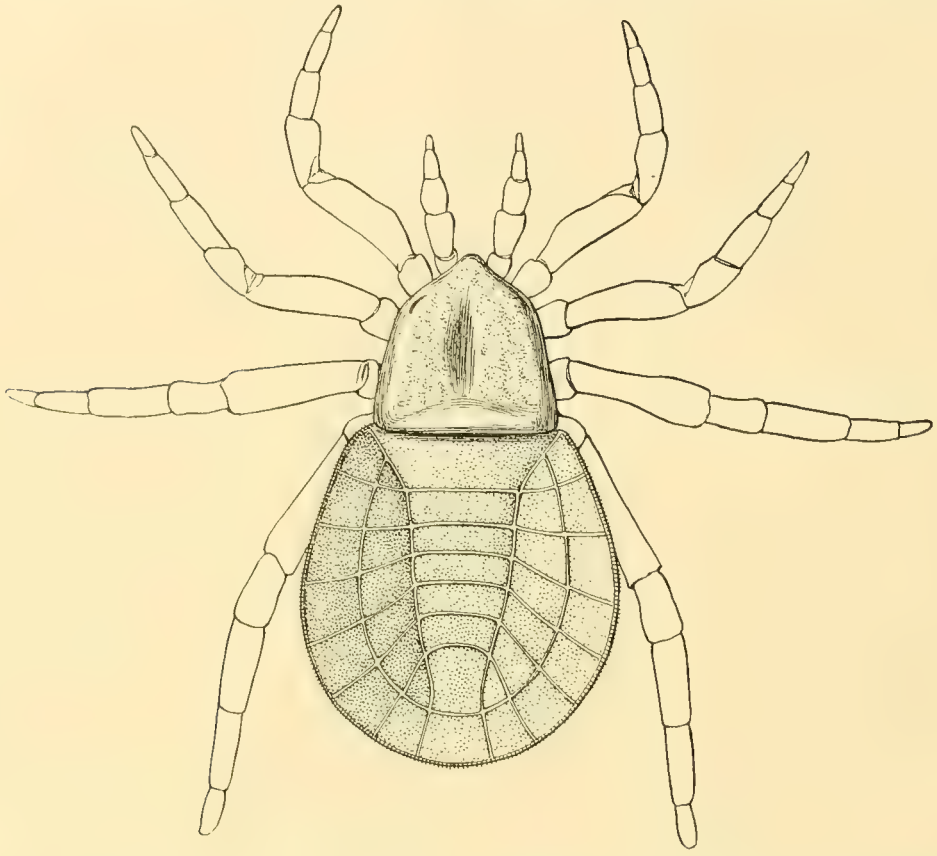


Fig. 30.—*Anthracomartus hindi*, sp. n.; restoration of dorsal surface with appendages, taken from several specimens, about two and a half times nat. size.—Coal Measures; Coseley, near Dudley.

of the second, third, fourth, fifth and sixth subequal; the posterior border of the median area of the first and second straight, of the third, fourth, fifth and sixth becoming gradually but only slightly more and more recurved; the length of the median area of the first plate about half its posterior width; of the second a little less than one third of its posterior width; the third to the sixth becoming progressively and gradually narrower, the median length of the sixth being about one-half its posterior width; median length of the seventh exceeding that of the first and

[1] In this and other cases where Anthracomartidæ are described, the first tergal plate of the opisthosoma is considered to be the seventh from the end on the dorsal side, the narrow anterior plate, which is often overlapped by the carapace, being disregarded.

equal to its own anterior width; length of the median lamina of the seventh about two-thirds the length of that plate. Palp with femur, patella, tibia and tarsus about three-quarters the length of the carapace; the femur and patella stout, the tibia and tarsus thinner. Trochanter and femur of first leg about as long as the first four terga of the opisthosoma; of fourth leg about as long as the first five terga.

Measurements in mm. (of type).—Total length 25; length of carapace 9, width 8; length of opisthosoma 16, width about 16; median length of its first tergum 2·8, of second + third 3; four distal segments of palpus 6; trochanter and femur of first leg 7, the rest of the limb 8·5; trochanter and femur of second about 7, the

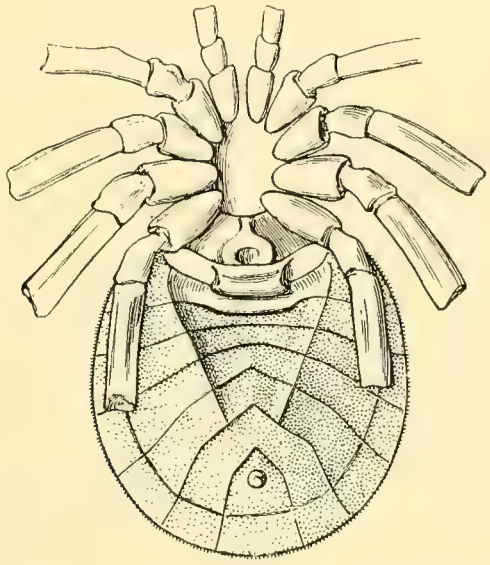


Fig. 31.—*Anthracomartus hindi*, sp. n.; suggested restoration of the ventral surface, about two and a half times nat. size.—Coal Measures; Coseley, near Dudley. From Dr. Wheelton Hind's specimen, No. 1.

rest of the limb 10·5; trochanter and femur of third about 7·5, of fourth about 8.

Dudley, and Coseley, near Dudley.

The type of this species is a cast (No. 12148), in the Geological Survey Museum, of the underside of the dorsal surface of a specimen from Dudley belonging to Dr. Kidston.

In addition to this I have seen the following specimens which may be referred to the same species.

(1) One in Dr. Hind's Collection showing the dorsal surface from the lower side and the ventral surface from the upper side, with the palpi and the four pairs of ambulatory limbs at least as far as the extremities of the femora; also the coxæ, represented by hollow spaces, and the intervening sternal area. The first leg appears to be relatively longer than in the type and has a considerably larger angular prominence in front; and the first tergal plate of the opisthosoma seems

to be distinctly shorter than the following two. These differences, however, are very likely sexual, the specimen under notice being perhaps the male and the type the female of the same species. The anterior sternal plates of the opisthosoma are difficult to decipher. The suggested restoration in the annexed figure may possibly, however, help their correct interpretation when other material is available. *Measurements in mm.*—Total length 22; length and width of carapace about 8; length of opisthosoma 13·5, width doubtful; length of trochanter and femur of first and fourth legs about 7.

(2) Specimen in Dr. Hind's Collection showing the dorsal surface and obscure details of the ventral sclerites, with the trochanters and femora of the four legs of the left side. The greatest width of the opisthosoma appears to be across its third segment, not across the fourth as in the type; this region is thus narrower behind; the first tergal plate of the opisthosoma is approximately only as long as the second and half the third, and the legs appear to be relatively shorter than in the other specimens, the process on the femur of the first being small. *Measure-*

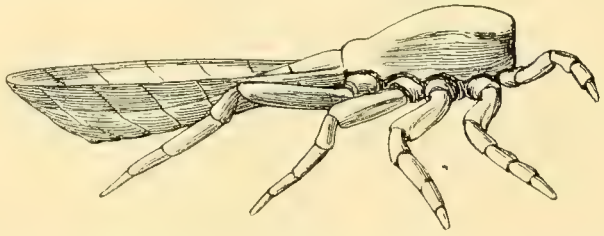


Fig. 32.—*Anthracomartus hindi*, sp. n.; suggested restoration of lateral surface, taken from several specimens, about two and a half times nat. size.—Coal Measures; Coseley, near Dudley.

ments in mm.—Total length 23·5, length of carapace 8·5, width doubtful; length of opisthosoma 15, approximate width 14; length of trochanter and femur of first leg 6; of fourth leg 6·5.

This specimen, perhaps, represents a different species from the rest.

(3) Specimen in Dr. Hind's Collection showing no details of special moment. *Measurements in mm.*—Total length 21; length of opisthosoma 13, width 12.

(4) Specimen in the British Museum, collected by Mr. J. S. Neil, showing the same general features as No. 1, belonging to Dr. Hind, but less clearly. *Measurements in mm.*—Total length 21·5; length of opisthosoma 15·5.

(5) Specimen in Mr. Egginton's Collection (No. 22) showing the dorsal surface, the opisthosoma being nearly complete, but the prosoma incomplete, without trace of appendages. *Measurements in mm.*—Total length 22; length of opisthosoma 15, width doubtful.

(6) A perfect specimen of the opisthosoma in Mr. Egginton's Collection (No. 29). *Measurements in mm.*—Length of opisthosoma 15, width 14.

(7) A small specimen in Mr. Priest's Collection appears to belong to this species rather than to the following on account of the shape of the seventh tergal

plate of the opisthosoma. *Measurements in mm.*—Total length 13; length of opisthosoma 9, width about 8.

All the above-described specimens are from Coseley, near Dudley.

Anthracomartus priesti, sp. nov. Text-figures 33, 34.

Carapace apparently a little longer than wide, its median length equal to that of first six and half the seventh tergal plates of the opisthosoma; both these areas granular or coriaceous throughout. The first tergal plate of the opisthosoma large, its median length equal to that of the second and third taken together; the median lengths of the second, third, fourth, fifth and sixth subequal; their posterior borders with approximately the same curvature as in *A. hindi*; length of median

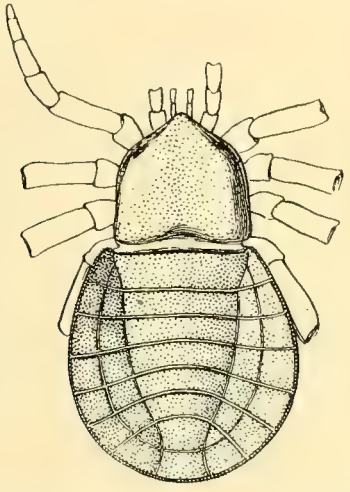


Fig. 33.—*Anthracomartus priesti,* sp n.; dorsal surface, restored from several specimens, four times nat. size.—Coal Measures; Coseley, near Dudley.

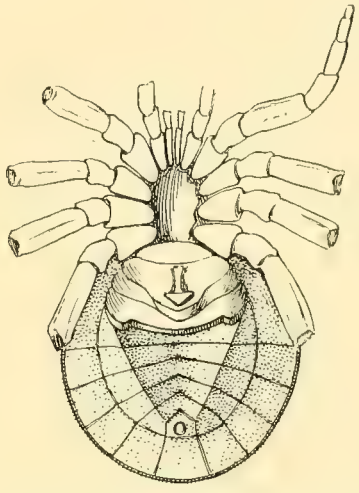


Fig. 34.—Suggested restoration of ventral surface of the same.

area of first plate less than one-half its posterior width; of the second a little more than one-fourth of its posterior width; of the sixth distinctly less than one-half its posterior width; median length of the seventh a little less than that of the first, and much less than its own anterior width; the triangular lateral laminæ of this segment nearly equal-sided; median length of the median unpaired lamina about equal to that of the seventh tergal plate itself.

Length of palpi doubtful. Trochanter and femur of first leg about equal to the median length of the first, second, third, and half the fourth terga of the opisthosoma; of fourth leg about equal to the first five terga of that region.

First sternal plate large and triangular, its posterior median angle nearly rectangular, the median area of the plate marked apparently with a somewhat arrow- or hammer-shaped crest, the handle or shaft lying in the middle line, and the head expanding laterally just in front of the angular prominence of the plate;

the second sternal plate shorter but wider than the first, with its median area elevated into a subcrescentic thickening which fits round the angle of the first; the third wider than the second, very short in the middle, thickened and notched laterally, where it is hinged to the fourth.

Measurements in mm.—Total length 11; length of carapace 4·5, width about 4; length of opisthosoma 6·5; median length of its first tergal plate about 1·3, of seventh about 1; length of trochanter and femur of first leg almost 3, of the rest of the limb 3·5; trochanter and femur of fourth leg 3·3.

Coseley, near Dudley.

The type specimen above described is in the collection of Mr. S. Priest.

In addition to the type I have seen many specimens in various stages of preservation in the Collections of Mr. S. Priest, Mr. Henry Johnson, Mr. W. Egginton, Dr. Hind, and Mr. J. S. Neil, all contained in clay ironstone nodules from Coseley and Dudley.

The following may be mentioned:

(1) A perfect specimen of the opisthosoma from the dorsal side in Mr. Priest's Collection. It differs principally from the type in having the median area of the seventh tergal plate longer than its unpaired lamina. Total length of the opisthosoma 6·5 mm., width 6 mm.

(2) Another specimen in Mr. Priest's Collection has the opisthosoma 6 mm. long and about 6·3 mm. wide.

(3) Specimen in Dr. Hind's Collection showing the same general features as the type, but the sterna of the opisthosoma less well preserved and the second, third, and fourth legs of the right side clearly traceable. The opisthosoma is shortened by distortion. *Measurements in mm.:* Total length 10; length of carapace 4·5, width 3·5; length of opisthosoma 5·5; length of second leg 5·5, of third 5·5, of fourth 6·3.

(4) Specimen in the British Museum collected by Mr. J. S. Neil and showing the dorsal surface, with the carapace incomplete. Total length about 11·5 mm.; length of opisthosoma 7 mm., width 7·5 mm.

(5) Specimen in Mr. Egginton's Collection (No. 5) showing the anterior sternal plates of the opisthosoma nearly as clearly as in the type. Total length about 12 mm., of which the opisthosoma is 7 mm; trochanter and femur of fourth leg 3 mm.

In addition to No. 5, Mr. Egginton's Collection contains ten specimens of Anthracomarti, most of which seem to belong to this species. Some, however, are of doubtful identity. The three following are selected for measurement on account of their small size: No. 26, total length 9 mm. No. 52, total length 7 mm.; length of opisthosoma 4·5 mm. No. 32, total length 5 mm.; length and width of opisthosoma about 3 mm.; length of first leg 3 mm. These may be young specimens of *A. priesti.*

Family Anthracosironidæ, Pocock.

1903. *Anthracosironidæ*, R. I. Pocock, Geol. Mag. [4], vol. x, p. 408.

Carapace of prosoma with only a single posterior transverse sulcus; elevated in the middle and sloped anteriorly, laterally and posteriorly to the borders, thus resembling in a general way that of the Anthracomartidæ. Opisthosoma with the pleural laminæ smaller than in that family and undivided, those on the anterior terga being very small. Anterior sterna of this region, at least in *Trigonotarbus*, small and crowded together, not enlarged, and posteriorly produced, the first triangular and wedged between the coxæ of the last pair of appendages, the following two or three short and not laterally impressed; the posterior border of the posterior sterna evenly convex, not mesially angled or notched.

This family constitutes in some respects an interesting connection between the Anthracomartidæ and the Eophrynidæ, resembling the former in the structure of the carapace and the latter in the shape and size of the anterior sterna of the opisthosoma.

The two genera referred to the Anthracosironidæ may be distinguished as follows:

a. Carapace rounded or truncated in front, its lateral borders only markedly converging in front of the middle; all the pleural laminæ directed obliquely backwards, their anterior and posterior borders forming distinct angles with the corresponding borders of the median area of the terga that bear them . . . *Anthracosiro.*

a'. Carapace markedly narrowed and angular in front, its lateral borders strongly converging forwards from a point behind the middle; the anterior and posterior borders of the pleural laminæ following the lines of the corresponding borders of the median area of the terga . . . . . *Trigonotarbus.*

Genus **ANTHRACOSIRO**, Pocock.

1903. *Anthracosiro*, R. I. Pocock, Geol. Mag. [4], vol. x, pp. 247—250 and 405—407.
1904. *Anthracosiro*, A. Fritsch, Palæoz. Arachn., p. 42.

Generic Characters.—Carapace high, convex from before backwards, and from side to side; its median area widely, but not deeply, excavated longitudinally, and defined by a ridge on each side, externally to which the surface slopes downwards to the lateral margin at an angle of about 45 degrees; the anterior portion of the upper surface bearing a pair of widely separated tubercles, probably oculiferous, or a transverse ridge at the ends of which eyes were probably situated; the lateral border strongly or slightly convex; the anterior border convex or nearly straight; the posterior border straight; a short area in front of the posterior border defined by a transverse groove. The opisthosoma with seven

very distinct terga, and in front of the seventh from the end (the first large tergal plate) one, or possibly two, narrower terga. The pleural plates quite small on the anterior terga, but becoming progressively longer from before backwards and tilted upwards and inclined backwards, so that the antero-lateral angle of each is obtuse and the postero-lateral angle acute; each composed of a single plate as in *Eophrynus* and *Kreischeria*, not of a double plate as in *Anthracomartus*. Appendages as in the other members of this order.

Type Species.—*Anthracosiro woodwardi*, Pocock.

Anthracosiro woodwardi, Pocock. Text-figures 35, 36.

1903. *Anthracosiro woodwardi*, R. I. Pocock, Geol. Mag. [4], vol. x, pp. 246—250, 405—408.
1909. *Anthracosiro latipes*, E. L. Gill, Trans. Nat. Hist. Soc. Northumb., Durham, Newcastle-on-Tyne, vol. iii, pp. 510—522, pl. xiii.

The type of this species is a specimen (No. I. 1551) in the British Museum, showing clearly the structure of the terga of the opisthosoma, portions of the walking legs and the carapace in vague outline. A second specimen (No. I. 1554) shows little more than the last, except that the radial arrangement of the coxæ of the limbs can be indistinctly deciphered. A third specimen (No. I. 1553), however, which I had not seen in 1903, has the carapace well preserved. Since this plate was previously unknown it is worth describing in detail.

It is wider than long, elevated and longitudinally convex mesially, but sloping away anteriorly, posteriorly and laterally from the highest point, which is situated near the centre of the dorsal surface. Anteriorly a distinct T-shaped ridge is traceable; the ridge representing the stem or upright portion of the letter lies in the middle line, and extends from the anterior edge of the carapace upwards to meet the ridge representing the transverse bar of the T. At each extremity of this an eye was probably situated. On each side of the median ridge there is a shallow depression. Behind the transverse ridge there extends backwards to the posterior border of the carapace a pronounced depression bordered on each side by a ridge, and constricted near the middle of the carapace so as to present the appearance of two triangular depressions set angle to angle, the posterior being much the larger of the two. Outside the ridge on each side there is a rather wide and deep longitudinal depression. Another depression, running transversely and continuous with the posterior angles of the median depression, is traceable in front of the posterior border of the carapace. Portions of the terga of the opisthosoma and of the appendages add nothing to our knowledge of these structures, with the important exception that a detached palpus shows this appendage to have been short and stout, the femur being especially strong and deep, with a rounded prominence near its base on the inferior edge.

Approximate measurements in mm.—Length of carapace 5·7, width 6; length of

palpus 7·7. The first leg is about equal to the anterior five tergal plates of the opisthosoma.

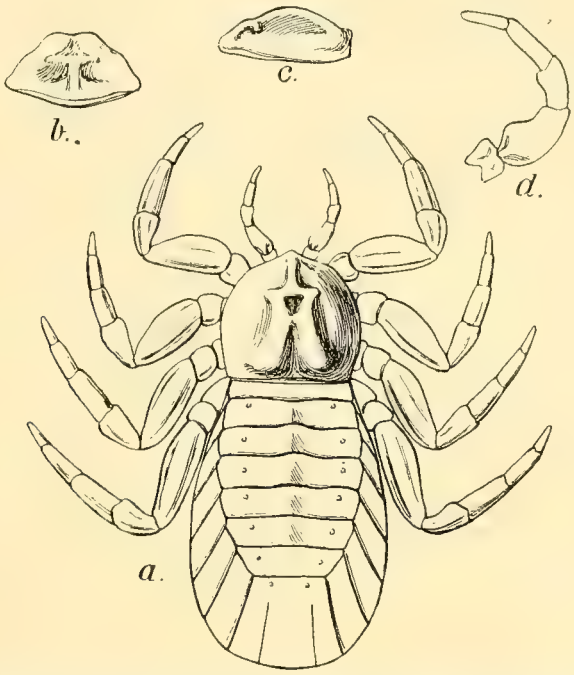


Fig. 35.—*Anthracosiro woodwardi*, Pocock. *a*. Restoration of the dorsal surface with appendages, taken from several specimens, about three times nat. size. *b*. Anterior, and (*c*.) lateral views of carapace of specimen No. I. 1553 in the British Museum. *d*. Detached palpus of the same, much enlarged.—Coal Measures; Coseley, near Dudley.

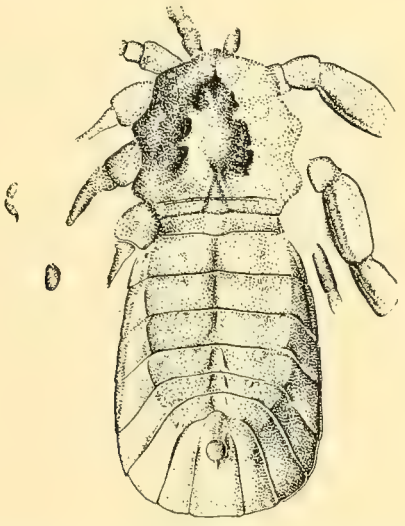


Fig. 36.—*Anthracosiro woodwardi*, Pocock; dorsal view, with the carapace crushed and the anal operculum showing through the last tergal plate visible on the upper side, about three times nat. size.—Coal Measures; Sparth, near Rochdale. W. A. Parker Collection.

In 1909 Mr. E. L. Gill described, under the name *A. latipes*, a species based upon a specimen from Crowcrook, near Newcastle-upon-Tyne, which differed apparently from the type of *A. woodwardi* in having the segments of the legs deep

and strongly compressed and crested. But by cutting away the matrix imbedding the limbs of examples of *A. woodwardi* in the British Museum, Dr. F. A. Bather has shown that the appendages are constructed as in the type of *A. latipes*. Since Dr. Bather drew my attention to this fact I have been able, through the kindness of Dr. Henry Woodward, to examine a specimen from Sparth, near Rochdale, belonging to Mr. W. A. Parker, which resembles those from Coseley and Crowcrook in the structure of the legs and in other particulars. Although Mr. Gill was perfectly justified on the evidence in describing his specimen as the representative of a new species, I think Dr. Bather is right in his belief that *latipes* must be regarded as a synonym of *woodwardi*. The specimen from Sparth shows the dorsal surface. The median ridge and the paired muscular impressions in the terga of the opisthosoma are clearly displayed. The pleural plates, however, are better preserved than in the type of *A. woodwardi* from Coseley, and those in the

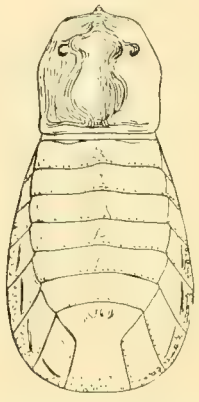


Fig. 37.—*Anthracosiro fritschi*, Pocock; dorsal surface, nearly eight times nat. size.—Coal Measures; Coseley, near Dudley. British Museum (No. I. 1556). From Geol. Mag. [4], vol. x, p. 406.

anterior portion of this region are shown to be, not triangular, as I described them, but four-sided, although the anterior margin is considerably shorter than the posterior margin. Another interesting feature to be noticed is the presence of a narrow tergal plate in front of the eighth from the end on the dorsal side as in *Eophrynus* and *Kreischeria*.

Measurements in mm.—Total length about 20; carapace about 5·5; opisthosoma, including the two narrower terga in front of the seventh from the end, 14·5—without these two terga 13; width 9; length of femur of fourth leg 4, width 2.

The known distribution of *A. woodwardi* is as follows: Coseley, near Dudley, specimens in the British Museum Nos. I. 1551 (type), I. 1553, I. 1554, formerly belonging to the Collection of Mr. H. Johnson; Sparth, near Rochdale, specimen belonging to Mr. W. A. Parker; Crowcrook, near Newcastle, the type of *A. latipes* in the Hancock Museum.

Anthracosiro fritschi, Pocock. Text-figure 37.

1903. *Anthracosiro fritschii,* R. I. Pocock, Geol. Mag. [4], vol. x, pp. 405—408, with fig.

Since no new material of this species has come to hand I can add nothing to the original description. The only known specimen measures 6·5 mm. in length.

Type in the British Museum (No. I. 1556) from the Coal Measures of Coseley, near Dudley (H. Johnson Coll.).

Genus **TRIGONOTARBUS,** nov.

Generic Characters.—Body forming an elongated oval, pointed at its anterior, rounded at its posterior end. Carapace high, markedly triangular in outline from above, widest at its posterior angles, its posterior border straight, its lateral borders slightly sinuous and converging forwards to the pointed anterior extremity. The median portion of its upper surface forming a flattish triangular area, from which the lateral and anterior portions slope somewhat abruptly away to the margin; the lateral portion hollowed posteriorly; the posterior portion of the carapace depressed and marked with a transverse groove parallel with the posterior border; the anterior sloping portion compressed. A pair of contiguous eyes on the anterior angle of the flattish area at the summit of the compressed sloping portion. Opisthosoma slightly convex between the laminæ, as wide as the carapace in front; its lateral and posterior borders forming an evenly oval curve, consisting above of seven distinct tergal plates nearly equal in length, each marked laterally with a groove defining the lateral upturned laminæ, which are smaller upon the anterior than upon the median and posterior terga, those of the first tergal plate being very small; the laminæ not directed so obliquely backwards as in *Anthracosiro.* The last tergal plate with three laminæ, the median completely separated from the laterals by the normal angled groove, but not separated by a groove from the main portion of the tergal area. Sternal surface of opisthosoma strongly convex from side to side, forming an even transverse curve across the middle line from the margin of the laminæ of one side to that of the other, but without any lateral groove defining the laminæ. The posterior border of the sternal plates mostly strongly recurved, but the recurvature becoming progressively less and less marked anteriorly; the sternal plate corresponding to the second tergal plate nearly straight from side to side; two or three plates in front of this, the number being uncertain, the anterior being triangular and projecting between the coxæ of the legs of the last pair; its posterior border concave, probably marking the anterior rim of the genital orifice. The last plate on the ventral surface bearing the circular anal sclerite.

The coxæ of the five pairs of post-oral appendages radiate round the elongated sternal area of the prosoma, which is about twice as long as wide. Of the first pair of appendages or cheliceræ no details can be determined. Those of the second pair, the first post-oral appendages or palpi, are normally constructed and pediform, consisting of six segments; the remaining pairs are similar in form and segmentation and approximately similar in size, each consisting of the usual number of seven segments.

Type Species.—Trigonotarbus johnsoni, sp. nov.

Although in the structure of its carapace this genus presents greater resemblance to *Anthracomartus* than to *Eophrynus*, it approaches much nearer to the latter than to the former in the structure of the sternal plates of the opisthosoma, especially of those in the region of the generative orifice. It also resembles

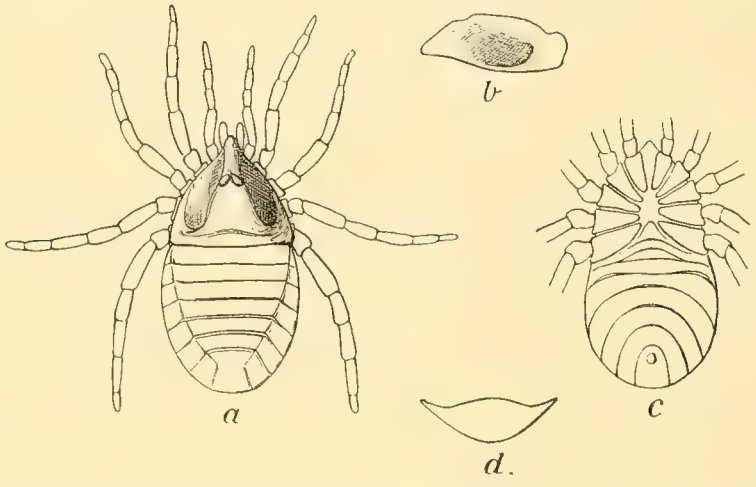


Fig. 38.—*Trigonotarbus johnsoni*, gen. et sp. n.; restoration from several specimens, about six times nat. size.—Coal Measures; Coseley, near Dudley. *a.*, dorsal surface with appendages; *b.*, lateral view of carapace, about eight times nat. size; *c.*, ventral surface; *d.*, transverse section of the opisthosoma to show the convexity of the ventral surface and the uptilted pleuræ.

Eophrynus in having the laminæ of this region undivided on the dorsal side, and not differentiated by a sulcus from the rest of the sternal plates on the sternal side of the opisthosoma. No doubt its nearest known ally is *Anthracosiro*, of which the sternal surface of the opisthosoma is unknown; but *Trigonotarbus* is certainly generically distinguishable by the shape of the carapace and of the laminæ of the opisthosoma, and by the absence of lateral constriction between the prosoma and opisthosoma.

Trigonotarbus johnsoni, sp. nov. Plate III, fig. 4; Text-figure 38.

Integument closely and tolerably uniformly granular. Carapace about as long as its own posterior width, and a little longer than the anterior six terga of the opisthosoma. Opisthosoma a little longer than wide; the terga subequal in length

mesially, the first not markedly longer than the rest; the first four straight, with parallel anterior and posterior borders; the fifth with its posterior border slightly recurved, the sixth with both anterior and posterior borders recurved or concave backwards. Palpi long and slender, excluding the coxa, longer than the carapace. First leg longer and stouter than the palpi, a little longer than the opisthosoma, and about one and a half times the length of the carapace, which is about equal to its trochanter, femur, patella, and half the tibia; the protarsus of the first leg apparently shorter than the tarsus. Fourth leg a little longer than the first, with its protarsus longer than its tarsus.

Measurements in mm.—Total length 4·8; length of carapace 2; of opisthosoma 2·8, width of latter about 2·5; length of palpus about 2·5; of first leg about 3, of fourth a little over 3.

Coseley, near Dudley.

Type, above described, in the Collection of Mr. Walter Egginton (No. 7).

In addition to the type there are many specimens in the Collections of Mr. Egginton, Mr. H. Johnson, and Mr. Madeley. They are all in clay ironstone nodules from the Dudley Coal Measures.

The largest specimens I have seen reach a length of about 6 mm.

Family Eophrynidæ, Karsch.

Eophrynidæ, Karsch, Scudder, Pocock, Fritsch.
Eophrynidæ + *Kreischeriidæ*, Haase.

Carapace with its median area elevated and marked with a deep, narrow longitudinal groove in its posterior half, and with one or two transverse sulci as well; furnished either anteriorly or mesially with an ocular tubercle bearing a pair of eyes. Behind the elevated portion there is a short depressed transverse portion abutting against the opisthosoma, and continuous laterally with the widely and horizontally extended lateral portion of the carapace, which is impressed with two sulci, the anterior of these being continuous with the sulcus of the median area that defines posteriorly the oculiferous area of the median portion. In front of the latter there is a longer or shorter apically narrow projecting portion, which apparently overhangs the cheliceræ. In typical members of this family (*Eophrynus*, *Kreischeria*) there appear to be at least two tergal plates in the opisthosoma in front of the seventh tergal plate from the end on the dorsal side, and the pleural laminæ, although large on all the seven normal and invariable terga, appear to be undivided. The anterior three sternal plates, at least in *Eophrynus*, are short, the first being triangular and wedged between the coxæ of the appendages of the last pair, the size and disposition of these plates being very similar to those of

Trigonotarbus amongst the Anthracosironidæ, and very different from those of the Anthracomartidæ.

The three British genera of this group may be distinguished as follows:

a. The posterior borders of the terga and of the pleural laminæ of the opisthosoma forming a transverse straight line, in no sense recurved . . . *Aphantomartus*.

a'. The posterior borders of the terga and of their pleural laminæ in the posterior half of the opisthosoma forming a markedly recurved line.

b. Carapace with median sulcus long and eyes far in advance of the middle, as in *Aphantomartus* . . . . . *Kreischeria*.

b'. Carapace with median sulcus short and eyes approximately central. *Eophrynus*.

In addition to the genera diagnosed above the following, not yet recorded from British deposits, have been referred to this family:

Stenotrogulus, Fritsch, based on *Eophrynus salmi*, Stur; *Cyclotrogulus*, Fritsch, based on *Eophrynus sturi*, Haase; *Petrovicia*, Fritsch, type *P. proditoria*, Fritsch; *Hemikreischeria*, Fritsch, based on *Kreischeria geinitzi*, Thevenin (= *thevenini*, Fritsch).[1]

The typical species of *Stenotrogulus*, *Cyclotrogulus*, and *Hemikreischeria* are certainly closely related to the species referred here to *Eophrynus* and *Kreischeria*, whatever be the value of the genera themselves. On the latter point, however, I can give no opinion since I have not seen the type specimens and am unable to place confidence in Fritsch's restorations. The same applies to *Petrovicia*.

Genus **EOPHRYNUS**, H. Woodward.

1837. *Curculioides*, W. Buckland, Bridgewater Treatise (2nd ed.), vol. ii, p. 76 (in part, *prestvicii*).
1871. *Eophrynus*, H. Woodward, Geol. Mag., vol. viii, p. 386, pl. xi.
1902–1903. *Eophrynus*, R. I. Pocock, Geol. Mag. [4], vol. ix, pp. 439—448 and 487—493; also vol. x, pp. 250—251.
1904. *Eophrynus*, A. Fritsch, Palæoz. Arachn., p. 46.

Type Species.—*Eophrynus prestvici* (Buckland).

Since no new material of this genus has come to hand since 1902—3, I have nothing to add to the description I gave of this genus in those years. The difficult morphological features then discussed remain as obscure as before.

[1] *Kreischeria geinitzi* was cited by Thevenin (Proc. Verb. Soc. d'Hist. Nat. d'Autun, vol. xv, p. 195, 1902), who ascribed the specific name to Brongniart. The species was re-named by Fritsch on the grounds that Brongniart gave no diagnosis or figure of the animal. I have therefore assigned the species to Thevenin, who figured and described the type specimen, from the Coal Measures of Valenciennes in France, as *Kreischeria geinitzi*.

Eophrynus prestvici (Buckland). Text-figure 39.

1837. *Curculioides prestvicii*, Buckland, Bridgewater Treatise (2nd ed.), vol. ii, p. 77, note, pl. xlvi, fig. 2.
1871. *Eophrynus prestvicii*, H. Woodward, Geol. Mag., vol. viii, pp. 386—388, pl. xi.
1902. *Eophrynus prestvicii*, R. I. Pocock, Geol. Mag. [4], vol. ix, pp. 440, fig. 1 on p. 490.
1904. *Eophrynus prestvicii*, A. Fritsch, Palæoz. Arachn., pp. 46—48, with fig.

The typical example of this species, discovered by Mr. W. Anstice and described

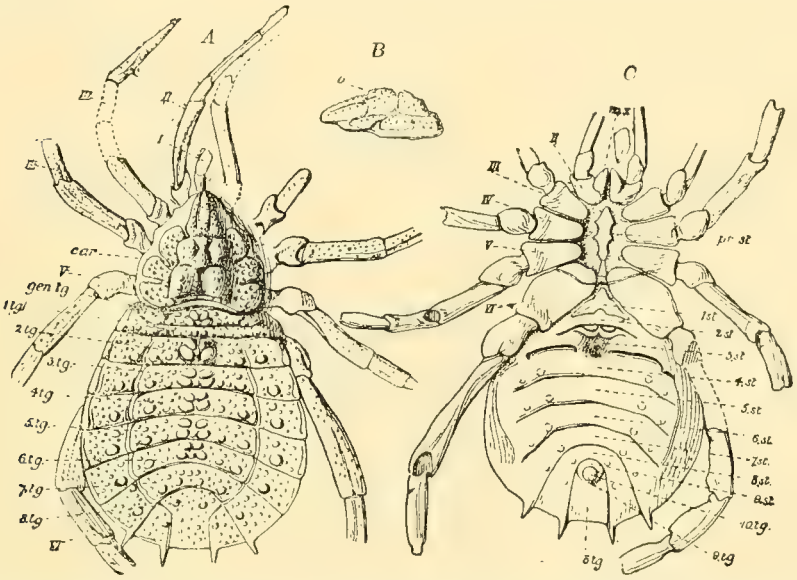


Fig. 39.—*Eophrynus prestvici* (Buckland); nearly twice nat. size.—Coal Measures; Coseley, near Dudley. *A*. Dorsal surface.—I to VI, appendages of the prosoma of the left side; *car.*, carapace; *gen. tg.* and *1 tg.*, first tergal plate of the opisthosoma apparently composed of the tergal elements of two somites; *2 tg.*, second tergal plate representing the first large tergal plate exposed in *Anthracomartus* and other genera; *3 tg. to 8 tg.*, third to the eighth tergal plates. *B*. Lateral view of carapace.—*o.*, eyes. *C*. Ventral surface.—II to VI, coxæ of postoral appendages; *mx.*, maxillary process of palpus; *pr. st.*, sternum of prosoma; *1 st.* to *9 st.*, sterna of first to ninth somites of the opisthosoma; *8 tg.*, lower side of the median lamina of the last tergal plate visible on the dorsal side; *9 tg.*, tergal plate of annuliform ninth somite; *10 tg.*, anal operculum or tergal plate of tenth somite. From Geol. Mag. [4], vol. ix, p. 490.

by Dean Buckland, came from Coalbrook Dale in Shropshire; the specimen described by Dr. Woodward and subsequent authors came from Dudley.

Genus **KREISCHERIA**, Geinitz.

1882. *Kreischeria*, H. B. Geinitz, Zeitschr. deutsch. geol. Ges., vol. xxxiv, p. 238, pl. xiv.
1890. *Kreischeria*, E. Haase, Zeitschr. deutsch. geol. Ges., vol. xlii, p. 642, pl. xxx, fig. 6.
1904. *Kreischeria*, A. Fritsch, Palæoz. Arachn., p. 50, fig. 63.

This genus, the type of which is *K. wiedei*, Geinitz, differs from *Eophrynus* at least in having the median sulcus of the carapace longer, wider, and expanding posteriorly, and the eyes well in advance of the middle of this plate. These

differences result from the greater development of the pre-ocular, and lesser development of the post-ocular region of the carapace in *Eophrynus* than in *Kreischeria*. In both these genera, as in *Aphantomartus*, it is quite clear that the eyes are situated upon that part of the median area of the carapace that corresponds to the anterior of the three pairs of lobes or segments of the lateral horizontally extended area.

The figures and description of the typical specimen of *K. wiedei*, published by Haase and Fritsch, are so irreconcileably discrepant that an accurate conception of the structure of the fossil is impossible. The species described below as new is certainly akin to that species, and I have decided on that account to refer it to the

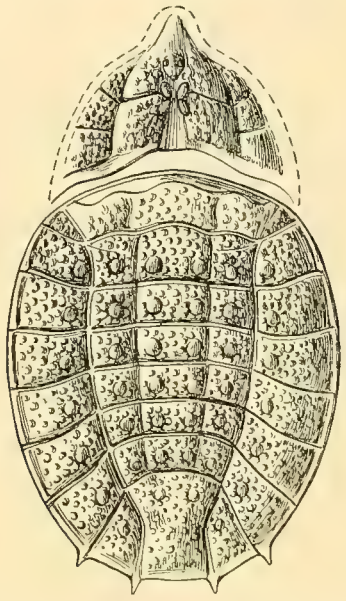


Fig. 40.—*Kreischeria verrucosa*, sp. n.; dorsal surface, about three times nat. size.—Coal Measures; South Wales. Museum of Geological Survey, London.

genus *Kreischeria*; but if the restoration of *K. wiedei* given by Fritsch is, as he claims, accurate, a new genus will probably have to be erected for *K. verrucosa*.

Kreischeria verrucosa, sp. nov. Plate III, fig. 5; Text-figure 40.

Carapace with four large and low suboval tubercles, lying behind the ocular tubercle and between it and the anterior end of the median sulcus, and set end to end in a rosette-shaped pattern; the anterior sulcus of the median area passing to the angle formed by the point of contact of the two tubercles on each side; a small median tubercle in the angle of the rosette just behind the ocular tubercle; the summit of the median elevated area of the carapace coarsely and rather closely tubercular; the sloping sides of the elevated area apparently smooth; the three segments of the horizontally extended area similarly tubercular, although the

inner portion of the median of the three laminæ is apparently smooth; all the tubercles irregular in size and more or less anastomosing; the central groove smooth. The entire dorsal surface of the opisthosoma covered with tubercles of varying size, which on the obverse show up as a number of pits separated by a network of ridges. Each of the posterior seven tergal plates, with exception of the seventh, divided more or less distinctly into five areas, a median elevated area, the pleural lamina on each side, and an intermediate area separated apparently by a joint from the pleural lamina, but only by a groove from the median more elevated area; the latter with two large tubercles, one on each side of the middle line, in addition to the smaller tubercles; the intermediate areas and the pleural laminæ each with one large tubercle, so that in all there are six rows of large tubercles on the dorsal surface. The structure of the seventh tergal plate is obscure; there are possibly two large tubercles on its median area, but there appear to be none on its pleural and median laminæ. The opisthosoma is evenly ovate in outline, being widely rounded in front, with its posterior extremity narrower and more truncated, and armed apparently as in *Eophrynus* with two pairs of short spiniform processes. The seventh tergal plate from the end, *i. e.* the first of the terga invariably shown in the Anthracomarti, is considerably longer than those that succeed it, but is otherwise similar to them, except that its intermediate area is marked in front with a groove defining a small lanceolate area. In front of this tergal plate there is a large plate with convex anterior border and marked with a transverse sinuous groove dividing it into an anterior shorter and a posterior longer portion, each of which may perhaps represent a tergal element; the posterior longer area has a distinct but small and triangular pleural lamina.

Measurements in mm.—Total length probably about 26; width of carapace about 10; length of opisthosoma 18, width 14·5.

Coal Measures of South Wales; Craigola Vein about 200 yards S.W. of Glyn-coch Farm.

Type and only known specimen (Nos. 25,020, 25,021) in the Museum of the Geological Survey, Jermyn Street.

Genus **APHANTOMARTUS**, nov.

Generic Characters.—Carapace with its median area longitudinally oblong and elevated; the elevated area divided with a transverse groove into two subequal portions, and marked with a deep median groove which passes forwards from the posterior border of the posterior portion on to the anterior portion, where it bifurcates on each side of the median ocular tubercle, which is situated near the anterior border of the anterior area. This tubercle bears a pair of eyes.

In front of the eye-bearing elevated portion there is a slightly lower anterior projection, about equal to it in width, the sides of which diverge posteriorly and are continuous with the lateral edge of the carapace; the summit of this projection is compressed to form a median crest with sinuous edges. The lateral portions of the carapace are depressed, somewhat widely extended beyond the elevated median area and marked with four grooves, the anterior of which is nearly longitudinal and lies alongside the anterior median projection; the following two are oblique, the first of them joining at its posterior end the transverse sulcus of the elevated area. The posterior groove is transverse and nearly in a line with the posterior border of the elevated area; it defines laterally the posterior part of the carapace, which is a short, wide area lying behind the median elevated portion; the posterior border of this, which abuts against the opisthosoma, is straight. The posterior angles of the carapace are rectangular, and the lateral margins slightly convex but becoming more strongly so anteriorly, where they curve inwards and forwards to meet the lateral margins of the anterior projecting portion; where the three posterior grooves reach the lateral margin they form angular projections making the lateral margin irregular in outline.

The opisthosoma shows only seven tergal plates; its anterior border where it abuts against the prosoma is straight; its sides are convex; at its widest it is as wide as the prosoma, and is narrowed and oval behind. The posterior border of all the tergal plates is straight and transverse, except of the last. Each plate is marked on each side by a sulcus separating a pair of lateral laminæ from the wider median portion of the tergum; these lateral plates are four-sided, with the exception of those of the seventh segment, which are triangular.

Type Species.—Aphantomartus areolatus, sp. nov.

Although obviously related to *Eophrynus* and *Kreischeria*, judging from the shape and segmentation of the carapace, this new genus decidedly differs from both not only in the structural details of that plate but also in those of the opisthosoma. For example, there is no sign of any segment or segments in front of the seventh from the end, and the posterior border of all the tergal plates is straight from side to side instead of presenting a strong recurvature at least in the posterior part of the body. The opisthosoma of *Aphantomartus*, indeed, differs very markedly from that of all the described genera of Eophrynidæ, especially at its posterior extremity. Some of it may possibly be buried in the matrix or missing, but the appearance of the fossil does not bear out this suggestion, the plausibility of which is further lessened by the occurrence of the same features in three specimens.

It is also possible that the peculiarities in the structure of the opisthosoma are due to immaturity, a possibility supported in a measure by the small size of the specimens as compared with the types of *Kreischeria verrucosa* and of *Eophrynus prestvici*. But although the possibility that the pleural laminæ increase in size

with growth must be borne in mind, there is as yet no evidence of the fact; and even were it known to be the case, the species now under discussion could not be assigned either to *Eophrynus* or *Kreischeria* on account of the structure of the carapace and the sculpturing of the opisthosoma.

Aphantomartus areolatus, sp. nov. Plate III, fig. 6; Text-figure 41.

Carapace wider than long, its median area with areolate sculpturing of large, low, contiguous tubercles, its lateral portions nearly smooth, slightly depressed. Terga of opisthosoma covered with large, low, mostly flattened tubercles, irregular in shape and varying in size; the first tergum with a large polygonal central tubercle encircled by smaller tubercles; between these and the pleural sulcus there

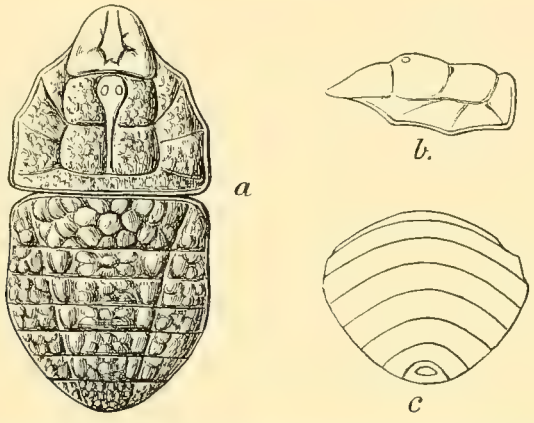


Fig. 41.—*Aphantomartus areolatus*, gen. et sp. n.; six times nat. size.—Coal Measures; South Wales. Museum of Geological Survey, London. *a.*, dorsal surface; *b.*, lateral view of carapace; *c.*, ventral surface of opisthosoma.

are several more tubercles, one of which on the postero-lateral angle of the median area of the tergum is a little more conspicuous than the rest, and subconical; the pleural plate also tubercular, one tubercle near its middle posteriorly being a little larger than the others. The succeeding terga very similarly sculptured, but with the large tubercle on the pleural plate and on the admedian side of the pleural sulcus still more conspicuous. These larger tubercles are not, however, present apparently on the tergum of the seventh segment.

Measurements in mm.—Total length about 9; length of carapace about 4, width 5; length of opisthosoma 5, width a little less.

Coal Measures of S. Wales: Mynyddislwyn vein; Gwernan level, three-quarters of a mile S.E. of Maes-y-cwmmer, and one-third of a mile E. of the Boot.

Type, above described, Nos. 25016 and 25017 in the Museum of the Geological Survey, Jermyn Street.

There is also a specimen (No. J. P. 565A) from the same locality and formation

in the Museum of the Geological Survey, which I regard as the posterior portion of the ventral surface of the opisthosoma of the same species. It is somewhat strongly convex from side to side, and like the ventral surface of *Eophrynus prestvicii* appears to be smooth, except for a few small symmetrically-arranged tubercles. The posterior portion of the fossil, however, is marked with a network of ridges, which I interpret as the pattern of the dorsal surface shown by the crushing of the sterna on the terga. The anal operculum is subterminal. In front of it there are seven concentrically curved plates, with the concavity of their posterior borders looking backwards; the first and second of these are much shorter than those that succeed them, the latter being subequal in length. The second plate is as wide as the third; the first, however, is much narrower, and tapers away to a point laterally. Total length and width about 5 mm.

A third specimen in the same collection (No. J. P. 402—403), also from the Mynyddislwyn vein in the Lebanus Colliery, by the roadside, two-thirds of a mile N. of Tredegar Junction, is represented by the posterior six segments of the opisthosoma, showing the characteristic sculpturing clearly on some of the plates. The total length and width are about 4·5 mm.

The species described by Scudder as *Anthracomartus pustulatus* (Proc. Amer. Acad. Arts Sci., vol. xx, p. 18, 1884; Mem. Bost. Soc. Nat. Hist., vol. iv, p. 452, pl. xl, figs. 5 and 8, 1890) shows many points of resemblance to this genus, and possibly belongs to it. In any case it cannot be referred to *Anthracomartus*. This specimen, from Mazon Creek, Illinois, appears to be either an impression of the dorsal surface or the underside of the dorsal exoskeleton, the pattern being a network of ridges circumscribing sunken polygonal "cells" or depressions. It may be noted that the posterior borders of the pleural plates and of the terga are in the same straight line, and that there is a long median groove on the carapace as in *Aphantomartus areolatus*. The pattern of the sculpturing, however, is different from that of the British species.

Order OPILIONES or ANTHRACOMARTI (?).

With considerable hesitation I refer to the Order Opiliones an Arachnid on a slab of shale from the Kiltoung Coal Seam, Ellismuir, sent to me by Mr. Robert Dunlop, who discovered it in 1888. It was in Dr. Peach's hands for some time, but was apparently never figured or described. The structural characters of the fossil are not sufficiently well preserved to make their exact interpretation possible. Since the surface is evidently closely granular I infer that the dorsal side is exposed, but owing to its being crushed, the outlines of the coxæ of at least the two posterior pairs of appendages are shown, and render obscure the form of the carapace in its

posterior region. From the shape of the fossil and the great length of the appendages I propose to identify it provisionally as :

Nemastomoides elaveris, Thevenin. Text-figure 42.

1902. *Nemastomoides elaveris,* A. Thevenin, Bull. Soc. Géol. France [4], vol. i, p. 609, pl. xiii, fig. 2.
1904. *Nemastomoides elaveris,* A. Fritsch, Palæoz. Arachn., p. 29, fig. 34.

The carapace appears to be broad in front and to have the antero-lateral angles subrectangular. Its anterior portion in front of the coxæ of the legs of the third pair is higher in the middle than at the sides, and has a central longitudinal groove

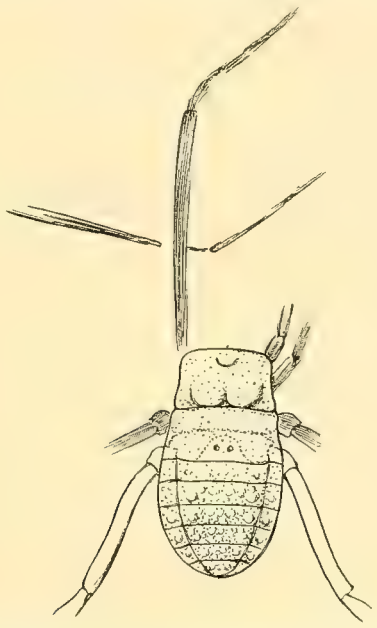


Fig. 42.—? *Nemastomoides elaveris,* Thevenin ; suggested restoration of the dorsal surface, five times nat. size.—Coal Measures ; Ellismuir. R. Dunlop Collection.

posteriorly. The coxæ of the third and fourth pairs of legs do not appear to meet in the middle line ; those of the third pair diverge transversely in the same straight line ; those of the fourth pair, about equal to them in size, diverge obliquely backwards, and between them there appears to be a triangular plate which must probably be regarded as the first sternal plate of the opisthosoma seen vaguely through the median area of the first tergal plate of that region. It is marked with a pair of distinct tubercles, belonging probably to the sculpturing of the dorsal surface. Behind this plate the outline and segmentation of the opisthosoma are clearly seen. Its shape is semi-elliptical, being broad in front, gradually narrowed and rounded behind. There are six distinct plates with their anterior and posterior borders subparallel, each consisting of a median area and a pair of uptilted pleural laminæ, as in typical Anthracomarti ; the pleural laminæ

of the last are quite small, and there is no evidence that there was a median unpaired extension of the last beyond the anus, which is not shown. The width of the opisthosoma is about equal to its length from the posterior end to the apex of the triangular intercoxal plate, the length from the latter point to the anterior end of the prosoma being a little longer than the length of the last four segments of the opisthosoma. The sculpturing of the opisthosoma consists of close-set granulation broken up into larger, indefinitely tubercular areas.

Leg of the fourth pair with its trochanter, femur, and patella almost as long as the entire body; leg of first pair extraordinarily long and slender, the femur alone exceeding the entire length of the body.

Measurements in mm.—Total length 6; length of the last six segments of the opisthosoma 3, width of the latter region 3·5; width of anterior portion of prosoma 3, its length to the anterior groove 1·7; femur of fourth leg about 4, of first leg about 7.

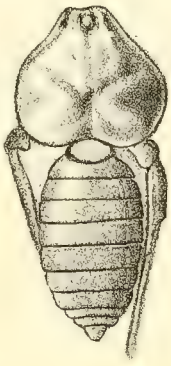
The specimen above described came from the Kiltoung Coal Seam, Ellismuir, Baillieston, in Scotland, and is in the Collection of Mr. Robert Dunlop.

The type of *N. elaveris* was from the Coal Measures at Commentry, in France.

PLATE I.

Fig.		Page.
1.	*Anthracoscorpio dunlopi*, sp. nov.; dorsal view of type and only known specimen, nat. size.—Upper Coal Measures, Drumgray, near Airdrie, Lanarkshire. R. Dunlop Collection. The outlines of the carapace and of the anterior terga of the opisthosoma are more clearly defined than in the original.	21.
2.	*Anthracoscorpio buthiformis*, sp. nov.; sternal surface of prosoma and tergal plates of opisthosoma, three times nat. size.—Coal Measures; Coseley, near Dudley. B. M. no. I. 1555.	27.
2 *a*.	Ditto; dorsal view, three times nat. size.—Ibid. W. Egginton Collection, no. 43. The anterior border of the carapace is much more clearly shown than in the original.	27.
3.	*Geralinura britannica*, sp. nov.; dorsal view of type specimen, three times nat. size.—Ibid. W. Egginton Collection, no. 51. The outlines of the segments of the chela are more clearly shown than in the original.	29.
4.	*Græophonus anglicus*, sp. nov.; dorsal view, three times nat. size.—Ibid. W. Egginton Collection, no. 40.	32.
4 *a*.	Ditto; dorsal view of type specimen, two and a half times nat size.—Ibid. W. Egginton Collection, no. 1.	32.
4 *b*.	Ditto; sternal surface of prosoma and tergal plates of opisthosoma, two and a half times nat. size.—Ibid. W. Egginton Collection, no. 20.	33.
4 *c*.	Ditto; same surfaces as in fig. 4 *b*, three times nat. size.—Ibid. W. Egginton Collection, no. 2.	32.
4 *d*.	Ditto; dorsal view of carapace, four times nat. size.—Coal Measures, near Neath, South Wales. Museum of Geological Survey, Jermyn Street, London.	33.

3. ×3



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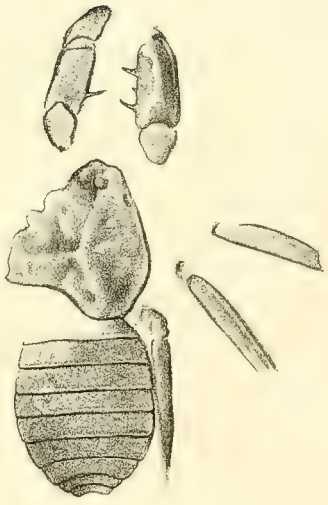

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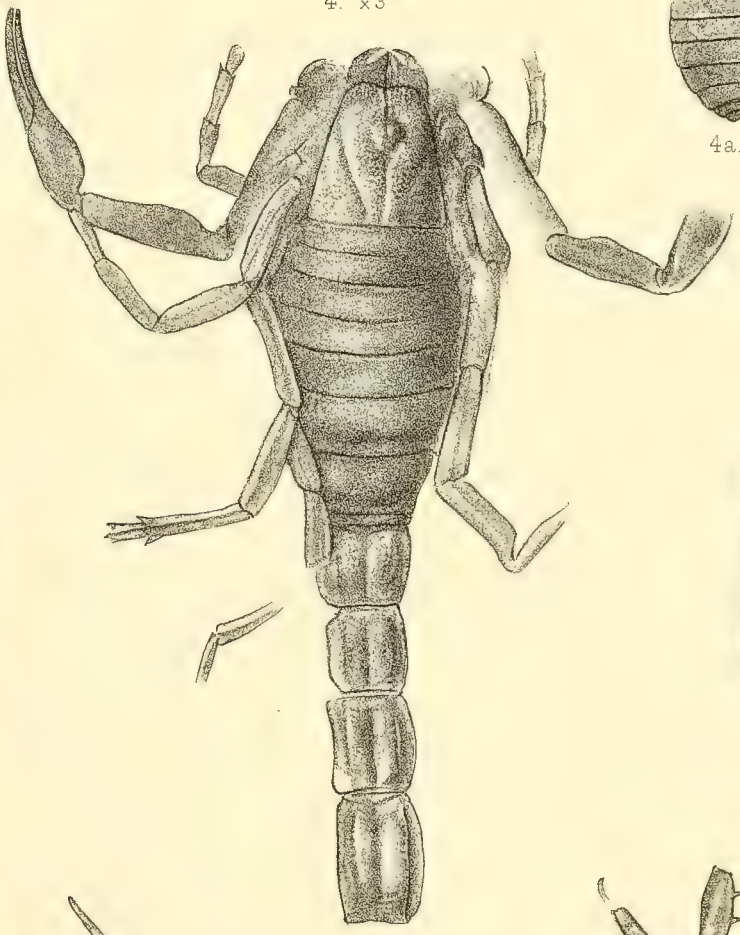
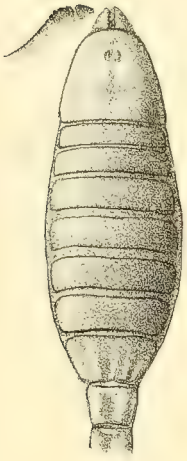


1. *nat. size.*



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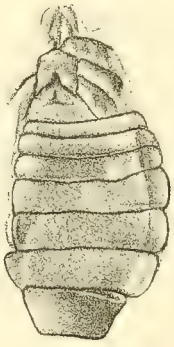

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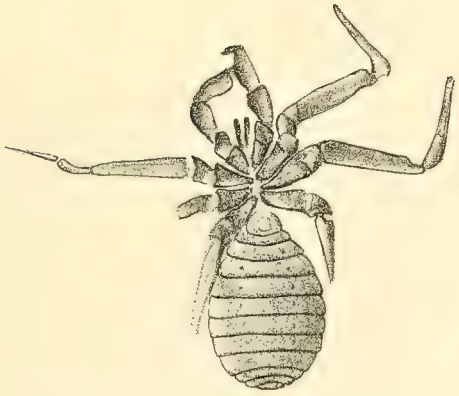
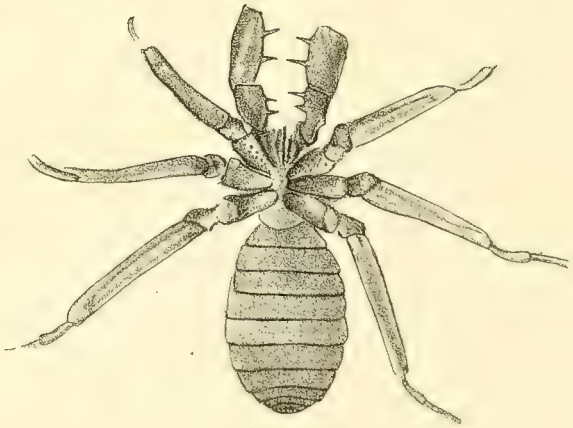


4c. ×3

4d. × 4



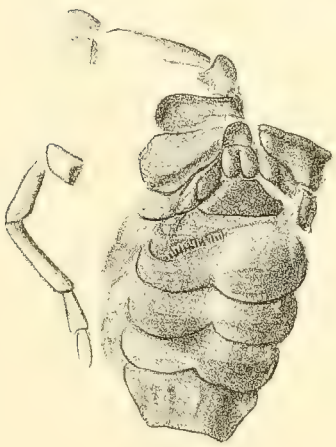
4b. × 2½

G.M. Woodward: del. et lith.

West, Newman imp.

PLATE II.

Fig.		Page.
1.	*Anthracoscorpio buthiformis*, sp. nov.; dorsal view of type specimen, four times nat. size.—Coal Measures; Sparth, near Rochdale. W. A. Parker Collection.	24.
2.	*Eobuthus holti*, sp. nov.; ventral view, nat. size.—Ibid. F. Holt Collection.	14.
2 *a*.	Ditto (?); ventral view of posterior end of opisthosoma, nat. size.—Coal Measures; Shipley, near Nottingham. L. Moysey Collection.	15.
2 *b*.	Ditto (?); dorsal view of same specimen, showing tergal plates crowded together and overlapping, nat. size.	15.
3.	*Geralinura britannica*, sp. nov.; dorsal view, three times nat. size.—Ibid. L. Moysey Collection.	30.
4.	*Eocteniza silvicola*, gen. et sp. nov.; dorsal view of type specimen, three times nat. size.—Coal Measures; Coseley, near Dudley. W. Egginton Collection.	34.
5.	*Plesiosiro madeleyi*, gen. et sp. nov.; dorsal view, five times nat. size.—Ibid. W. Egginton Collection, no. 4.	44.
6.	*Poliochera alticeps*, sp. nov.; dorsal view of type specimen, seven times nat. size.—Ibid. W. Egginton Collection, no. 6.	40.
7.	*Curculioides ansticii*, Buckland; dorsal view, four times nat. size.—Ibid. W. Egginton Collection, no. 33.	39.
7 *a*.	Ditto; ventral view of same specimen (exact shape of coxæ doubtful), four times nat. size.	39.



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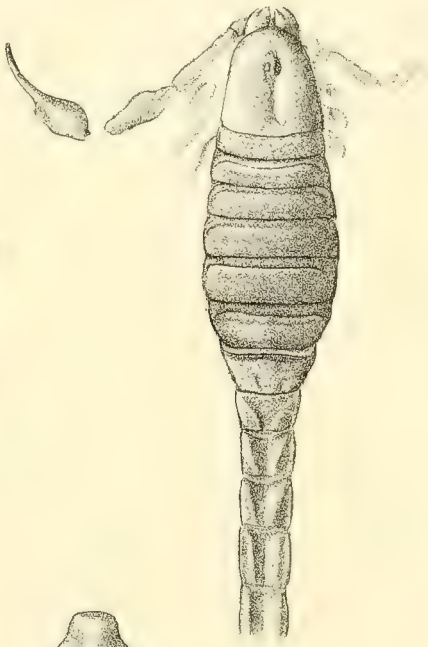
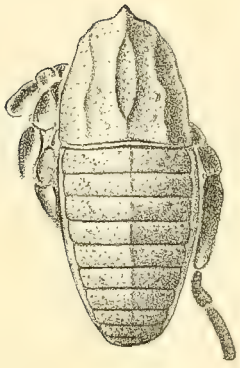


1. ×4

2a. *nat.size*

2b. *nat.size*

4. ×3



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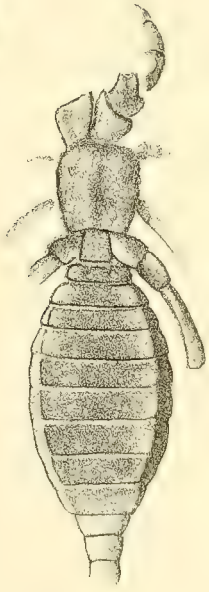

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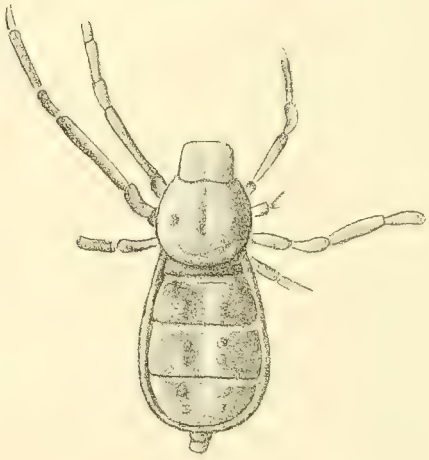
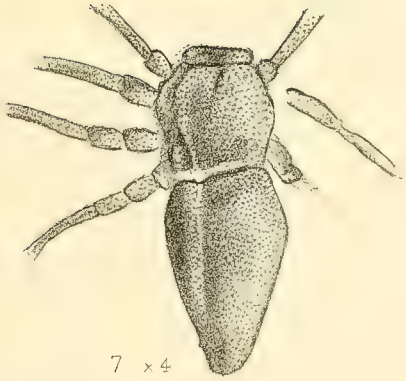


6. ×7



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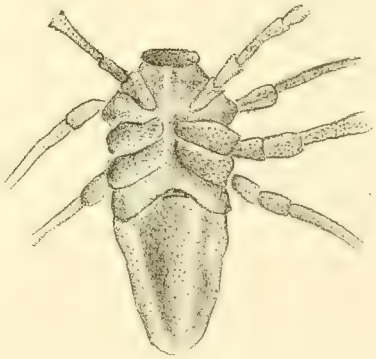
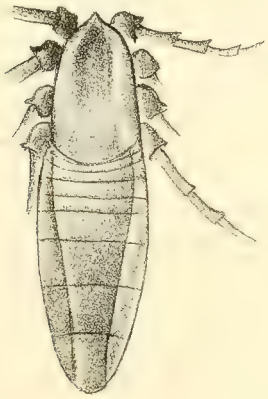


7a. ×4

PLATE III.

Fig.		Page.
1.	*Geraphrynus torpedo*, sp. nov.; dorsal surface of type specimen from below, four times nat. size.—Coal Measures; Coseley, near Dudley. W. Egginton Collection, no. 10.	54.
1 *a*.	Ditto; ventral surface of same specimen from above, four times nat. size.	54.
2.	*Geraphrynus angulatus*, sp. nov.; dorsal surface of type specimen from below, four times nat. size.—Ibid. Wheelton Hind Collection.	49.
2 *a*.	Ditto; ventral surface of same specimen from above, four times nat. size.	49.
3.	*Anthracomartus hindi*, sp. nov.; dorsal surface of type specimen from below, twice nat. size.—Ibid. Museum of Geological Survey, Jermyn Street, no. 12148.	64.
4.	*Trigonotarbus johnsoni*, gen. et sp. nov.; dorsal surface of type specimen, seven times nat. size.—Ibid. W. Egginton Collection, no. 7.	74.
4 *a*.	Ditto; ventral surface of same specimen, seven times nat. size.	74.
5.	*Kreischeria verrucosa*, sp. nov.; dorsal view of type specimen, two and a half times nat. size.—Coal Measures; South Wales. Museum of Geological Survey, Jermyn Street, nos. 25,020—21.	78.
6.	*Aphantomartus areolatus*, gen. et sp. nov.; dorsal view of type specimen, five times nat. size.—Coal Measures; South Wales. Museum of Geological Survey, Jermyn Street, nos. 25,016—17.	81.

Pocock, British Carboniferous Arachnida. Pl. III.



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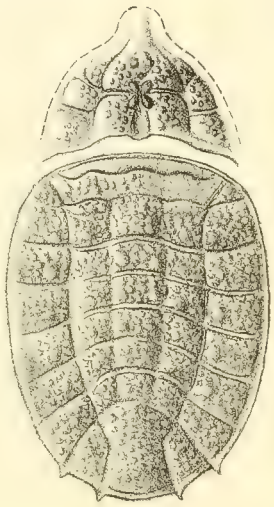

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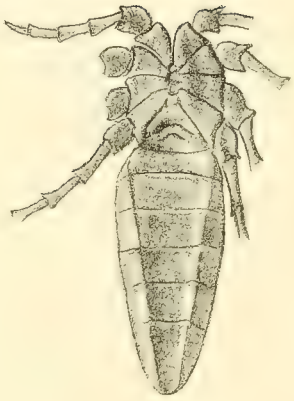

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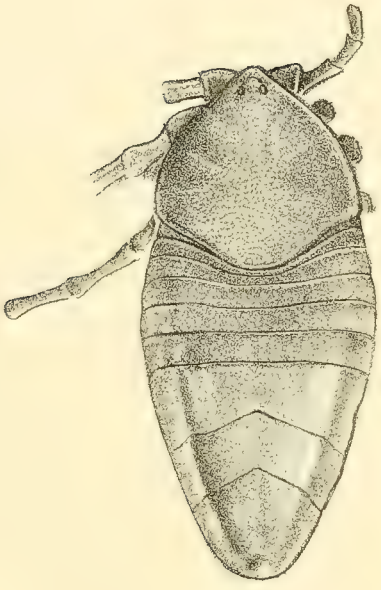

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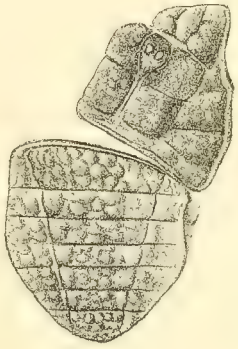

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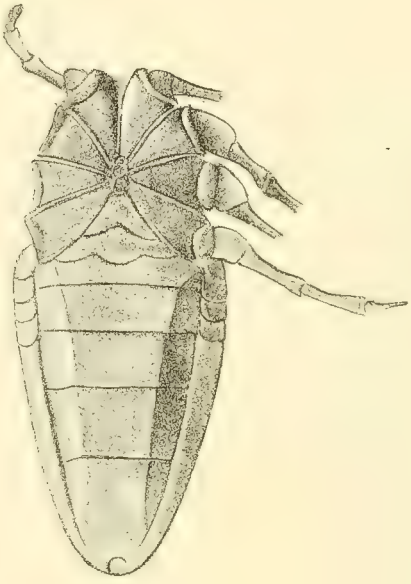
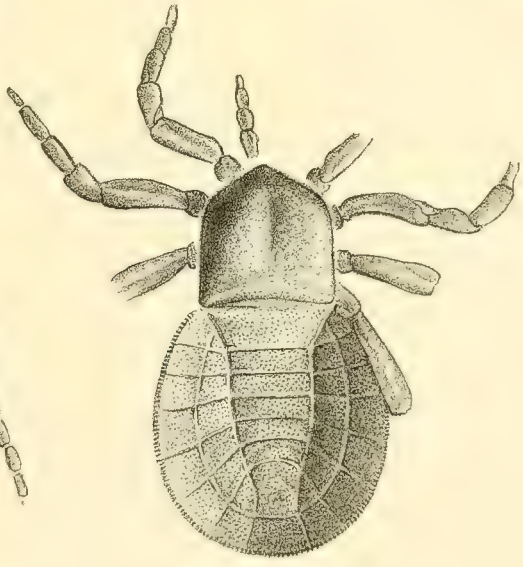
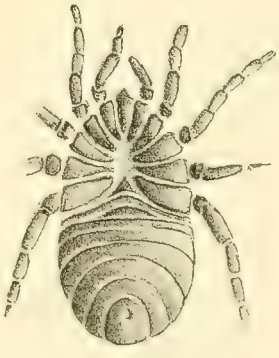


2a. ×4

4. ×7



3. ×2



4a. ×7

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